



FAA-STD-029
February 26, 1986

U.S. Department of Transportation
Federal Aviation Administration
Standard

SELECTION AND IMPLEMENTATION OF TELECOMMUNICATIONS STANDARDS

INITIATED BY: AES-120

FOREWORD

This standard contains telecommunication (voice and data) standards for use by the Federal Aviation Administration (FAA) in the acquisition of new telecommunications equipment/ Systems. This standard also serves as a reference document for the FAA telecommunications program.

Selection of the appropriate standards contained within FAA-STD-029 for inclusion in procurement packages is accomplished in the following manner:

- A. Identify the telecommunications interfaces addressed within the procurement action and those presently existing telecommunications interfaces which are impacted by the procurement.
- B. Consult FAA-STD-029, Section 3, and identify, within the constraints imposed by the existing equipment, the appropriate applicable standards. Where clarification is necessary, selection and application criteria are contained in Appendix I for data standards and Appendix II for voice standards.
- C. Examine in detail each potentially appropriate standard and select the ones which best define the interface requirements.
- D. Extract the appropriate technical requirements portion of the solicitation wording for inclusion in the procurement package.

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1. SCOPE

1.1 Scope. This standard provides telecommunication standards for use by the Federal Aviation Administration (FAA) in the preparation of specifications and related procurement documents for the lease or purchase of telecommunication systems, services or equipment.

1.2 Use. This standard is to be used by FAA personnel in the selection of telecommunications standards for FAA use. This standard will not be a referenced document in a procurement request package.

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of the standard to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of the referenced document shall be considered the superseding requirement.

STANDARDS:

Federal

FED-STD-1001/FIPS PUB 37
(FIRMR 201-8.113-1)

Synchronous High Speed
Data Signaling Rates
Between Data Terminal
Equipment And Data
Communication Equipment

FED-STD-1002
(FIRMR 201-8.112-1)

Time and Frequency
Reference Information In
Telecommunication Systems

FED-STD-1003/FIPS PUB 71
(FIRMR 201-8.113-6)

Synchronous Bit-Oriented
Data Link Control
Procedures (Advanced Data
Communication Control
Procedures)

FED-STD-1005
(FIRMR 201-8.112-4)

Coding And Modulation
Requirements For 2400 Bit/
Second Modems

FED-STD-1006
(FIRMR 201-8.112-5)

Coding And Modulation
Requirements For 4800 Bit/
Second Modems

FED-STD-1007
(FIRMR 201-8.112-6)

Coding And Modulation
Requirements For Duplex
9600 Bit/Second Modems

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FED-STD-1008
(FIRMR 201-8.112-7)

Coding And Modulation
Requirements For Duplex
600 And 1200 Bit/Second
Modems

FED-STD-1010/FIPS PUB 16-1
(FIRMR 201-8.113-2)

Bit Sequencing Of The
American National
Standard Code
For Information
Interchange In Serial-By-
Bit Data Transmission

FED-STD-1011/FIPS PUB 17-1
(FIRMR 201-8.113-3)

Character Structure And
Character Parity Sense
For Serial-By-Bit Data
Communication In The
Code For Information
Interchange

FED-STD-1012/FIPS PUB 18-1
(FIRMR 201-8.113-4)

Character Structure And
Character Parity Sense For
Parallel-By-Bit Data
Communication In The
American National Standard
Code For Information
Interchange

FED-STD-1013/FIPS PUB 22-1
(FIRMR 201-8.113-5)

Synchronous Signaling
Rates Between Data
Terminal Equipment And
Data Circuit-Terminating
Equipment Utilizing 4kHz
Circuits

FED-STD-1018

Interface Between Data
Circuit/Terminating
Equipment (DCE) and the
Public Switched Telephone
Network (PSTN)

FED-STD-1020
(FIRMR 201-8.112-11)

Electrical Characteristics
Of Balanced Voltage
Digital Interface Circuits

FED-STD-1026

Interoperability And
Security Requirements For
Use Of The Data Encryption
Standard In The Physical
Layer Of Data
Communications

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FED-STD-1027
(FIRMR 201-8.112-13)

General Security
Requirements For Equipment
Using The Data Encryption
Standard

FED-STD-1030
(FIRMR 201-8.112-14)

Electrical Characteristics
Of Unbalanced Voltage
Digital Interface Circuits

FED-STD-1041/FIPS PUB 100
(FIRMR 201-8.112-7)

Interface Between Data
Terminal Equipment And
Data Circuit-Terminating
Equipment For Operation
With Packet-Switched Data
Telecommunications
Networks

FED-STD-1061
(FIRMR 201-8.112-16)

Group 2 Facsimile
Apparatus For Document
Transmission

FED-STD-1062
(FIRMR 201-8.112-17)

Group 3 Facsimile
Apparatus For Document
Transmission

FED-STD-1063
(FIRMR 201-8.112-18)

Procedures For Document
Facsimile Transmission

National Bureau of Standards Program

FIPS PUB 1-2
(FIRMR 201-8.105-1)

Code For Information
Interchange, Its Represen-
tations, Subsets, and
Extentions

FIPS PUB 2-1
(FIRMR 201-8.105-2)

Perforated Tape Code For
Information Interchange

FIPS PUB 3-1
(FIRMR 201-8.105-3)

Recorded Magnetic Tape For
Information Interchange
(800 CPI, NRZI)

FIPS PUB 16-1/FED-STD-1010
(FIRMR 201-8.113-2)

Bit Sequencing Of The
Code For Information
Interchange In
Serial-By-Bit Data
Transmission

FIPS PUB 17-1/FED-STD-1011
(FIRMR 201-8.113-3)

Character Structure And
Character Parity Sense For
Serial-By-Bit Data
Communication In The Code
For Information
Interchange

FIPS PUB 18-1/FED-STD-1012
(FIRMR 201-8.113-4)

Character Structure And
Character Parity Sense For
Parallel-By-Bit Data
Communication In The Code
For Information
Interchange

FIPS PUB 22-1/FED-STD-1013
(FIRMR 201-8.113-5)

Synchronous Signaling
Rates Between Data
Terminal And Data
Communication Equipment

FIPS PUB 25
(FIRMR 201-8.105-8)

Recorded Magnetic Tape For
Information Interchange
(1600 CPI, Phase Encoded)

FIPS PUB 37/FED-STD-1001
(FIRMR 201-8.113-1).

Synchronous High Speed
Data Signaling Rates
Between Data Terminal
Equipment And Data
Communications Equipment

FIPS PUB 46
(FIRMR 201-8.105-15)

Data Encryption Standard

FIPS PUB 50
(FIRMR 201-8.105-16)

Recorded Magnetic Tape For
Information Interchange,
6250 CPI (246 cpm),
Group Coded Recording

FIPS PUB 52

Recorded Magnetic Tape
Cartridge for Information
Interchange, 14 Track,
6.30mm (1/4 inch), 63
bpm (1600 bpi) Phase
Encoded

FIPS PUB 53
(FIRMR 201-8.110-1)

Transmittal Form For
Computer Magnetic Tape
File Properties

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FIPS PUB 58
(FIRMR 201-8.106-4)

Representation of Local
Time of The Day For
Information Interchange

FIPS PUB 59
(FIRMR 201-8.110-1)

Representation of
Universal Time, Local
Time Differentials And
United States Time Zone
References For
Information Interchange

FIPS PUB 71/FED-STD-1003
(FIRMR 201-8.113-6)

Advanced Data
Communication Control
Procedures (ADCCP)

FIPS PUB 79
(FIRMR 201-8.106-5)

Magnetic Tape Labels And
File Structure For
Information Interchange

FIPS PUB 86
(FIRMR 201-8.105-30)

Additional Controls For
Use With American
National Standard Code
For Information
Interchange

FIPS PUB 98
(FIRMR Temp. Reg. 2)

Message Format For
Computer-Based Message
Systems

FIPS PUB 100/FED-STD-1041
(FIRMR 201-8.112-7)

Interface Between Data
Terminal Equipment And
Data Circuit Terminating
Equipment For Operations
With Packet-Switched Data
Communications Networks

FIPS PUB 107
(FIRMR Number Under Development)

Local Area Networks:
Baseband Carrier Sense
Multiple Access with
Collision Detection Access
Method and Physical Layer
Specifications and Link
Layer Protocol

General Services Administration:

Form SF-277

Physical Properties and
Characteristics of
Recorded Tape Files

National Communications Security Committee

NCSC-11

National Policy for
Protection of
Telecommunications
Systems Handling
Unclassified National
Security Information

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the procuring activity or as directed by the contracting officer.

2.2 Non-Government documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of the standard to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this standard, the contents of the referenced document shall be considered the superseding requirement.

STANDARDS:

American Telephone and Telegraph (AT&T)

PUB 41008

Analog Parameters Affecting
Voiceband Data Transmission
Description Of Parameters

PUB 41011

Transmission Specifications for
Voice Grade Private Line Audio
Tone Protective Relaying Channels

PUB 43002

Functional Criteria - Voice
Frequency Network Channel
Terminating Equipment - Metallic
Facilities

PUB 43003

Functional Criteria - Voice
Frequency Transmission -
Equipment - Maintenance
Terminating Unit - 2-Wire
Special Services

PUB 43004

Functional Criteria - Voice
Frequency Transmission -
Equipment - Maintenance
Terminating Unit - 4-Wire
Special Services

PUB 43005	Functional Criteria - Voice Frequency Network Channel Terminating Equipment Impedance Compensator with Gain
PUB 43101	Voice Grade Entrance Facilities For Extending Customer - Provided Communications Channels
PUB 43201	Private Line Interconnection Voice Applications
PUB 43301	Bell System Domestic Public Land Mobile Radio Service Interface Specification For Customer - Provided Dial Mobile Terminals - Preliminary
PUB 43401	Transmission Specifications For Private Line Metallic Circuits - Preliminary
PUB 43701	Private Line Interconnection - Connection To A Channel Of A Communications System - Preliminary
PUB 43720	Private Line Interconnection - Operational Features Of Bell System Switch Terminations
PUB 43802	Digital Multiplexes - Requirements and Objectives
PUB 43803	Facility Maintenance Features Required For Interoffice Digital Transmission Equipment
PUB 43804	Network Terminal Equipment Operations Interface Specification
PUB 43806	Generic Metropolitan Interoffice Digital Lightwave Systems - Requirements and Objectives

PUB 61310	Circuit Switched Digital Capability Network Access Interface Specifications
PUB 62103	High Performance Data Conditioning - Type D5 For Multi-Point Private Line Data Channels
PUB 62113	Network Channel Interface Specifications For Off-Premises Station Lines (PBX End)
PUB 62114	Network Channel Interface Specifications For Tie Trunks That Accommodate Registered Terminal Equipment Having Facility Interface Codes TL31M and TL32M - Preliminary
PUB 62115	Network Channel Interface Specifications For Tie Trunks That Accommodate Registered Terminal Equipment Having Facility Interface Codes TL31E and TL32E
PUB 62200	Group and Super group Spectrum - Description And Interface Specification
PUB 62310	Digital Data System Channel Interface Specification
PUB 62411	High Capacity Digital Service Channel Interface Specification Preliminary
PUB 62500	Voice Grade Switched Access Service Transmission Parameter Limits And Interface Combinations
PUB 62501	Voice Grade Special Access Service Transmission Parameter Limits And Interface Combinations

PUB 62502	Narrow Band Special Access Service Transmission Parameter Limits And Interface Combinations
PUB 62503	Program Audio Special Access Service Transmission Parameter Limits And Interface Combinations
PUB 62504	Television Special Access Service Transmission Parameter Limits And Interface Combinations
PUB 62505	Wideband Analog Special Access Service Transmission Parameter Limits and Interface Combinations
PUB 62506	Wideband Digital Special Access Service Transmission Parameter Limits and Interface Combinations
PUB 62507	Digital Data Special Access Service Transmission Parameter Limits and Interface Combinations
PUB 62508	High Capacity Digital Access Service Transmission Parameter Limits and Interface Combinations
American National Standards Institute (ANSI)	
ANSI X3.63-1981	General, Physical and Magnetic Requirements for Unrecorded Twelve-Disk Pack (100 Megabytes)
Institute of Electrical and Electronic Engineers (IEEE)	
IEEE-STD 783-1984	IEEE Standard Methods and Equipment for Measuring the Transmission Characteristics of Analog Voice Frequency Circuits.
International Civil Aviation Organization (ICAO)	
Annex 10, Volume 1	Aeronautical Telecommunications

International Organization for Standardization

ISO 7498

Information Processing Systems -
Open Systems Interconnection -
Basic Reference Model

International Telegraph and Telephone Consultive Committee (CCITT)

Recommendation X.25

Interface between Data Terminal
Equipment (DTE) and Data Circuit
Terminating Equipment (DCE) for
Terminals Operating in the
Packet Mode on Public Data
Networks

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. REQUIREMENTS

3.1 General. The FAA telecommunication standards activity covered by this standard is a result of standardization efforts taking place external to the agency. The standards appropriate to FAA systems, services and equipment have been selected from data, voice and transmission standards developed or implemented by the following organizations or groups: American National Standards Institute (ANSI), General Services Administration (GSA), International Organization for Standardization (ISO), International Telephone and Telegraph Consultive Committee (CCITT), National Bureau of Standards (NBS), American Telephone and Telegraph (AT&T), Electronic Industry Association (EIA) and the International Civil Aviation Organization (ICAO). A Federal Information Processing Standard Publication (FIPS PUB) may reference a technical standard adopted by ANSI. A Federal Standard (FED-STD) refers to a technical standard adopted by the Federal Telecommunications Standards Program. Careful selection and application of these standards will allow agency systems to evolve more efficient interfaces as well as meet transition and interoperability requirements. The FAA telecommunications standards activity must therefore be tightly controlled during the planning and upgrading process for National Airspace System (NAS) and agency support systems identified in the Information Resource Management Plan. The standards selected for the FAA are from three categories:

- a. Mandatory standards are those imposed by a U.S. authority on government systems and equipment.
- b. Treaty standards are international standards such as those imposed by CCITT, ICAO or regulatory bodies.
- c. Voluntary Standards are standards which are highly desirable for interoperability and system cost avoidance purposes. Certain voluntary standards, such as those agreed to by EIA and others, have been, or soon may be, adopted as mandatory by the U.S. Government.

3.1.1 Appendices. Appendices I and II are included as design guidelines.

3.2 Data communications. This subsection details the basic information necessary to describe relevant communications standards. Information is provided concerning the purpose of the document, its applicability, provisions for waivers, and technical requirements portion of the solicitation wording. A description in summary form of the features or parameters of the data communications standards, selection criteria, and an inventory of essential technical characteristics of each standard are included where appropriate.

3.2.1 Parameters and selection criteria.

3.2.1.1 Interchange codes and media.

3.2.1.1.1 FIPS PUB 1-2. FIPS PUB 1-2 is a mandatory standard and shall be used to promulgate the American Standard Code for Information Interchange (ASCII) and specifies the code and character set for use in Federal information processing systems, communications systems and associated equipment. It is used in conjunction with FIPS PUB 2-1 and FIPS PUB 3-1.

3.2.1.1.1.1 Applicability. The standard shall be applicable to all computer and related equipment configurations brought into the federal inventory, acquired or leased with federal funds. It also applies to data systems developed at government expense, if such data is to be a part of the data base of a federal agency. Related equipment includes all character-oriented equipment in which magnetic tape or perforated tape is produced for input to a computer based data system or received as output from a computer based data system.

3.2.1.1.1.2 Waivers. Waivers to this standard shall be obtained from the Administrator.

3.2.1.1.1.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "The system, upon receiving a hardware or software command, shall accept data on magnetic tape, paper tape, or any other input media covered by an approved Federal Information Processing Standard Publication (FIPS PUB) in ASCII code and collating sequence prescribed in FIPS PUB 1-2 and in the format prescribed in FIPS PUBS 2, 3-1, 25, 50, or other applicable FIPS PUBS. Such data shall be translated, if necessary, into a form that the proposed equipment can internally process, provided that, upon receiving a hardware or software command, the proposed equipment can produce processed data on magnetic tape, paper tape, and other output media in the ASCII code and collating sequence prescribed in FIPS PUB 1-2 and in the format prescribed in FIPS PUBS 2, 3-1, 25, 50, or other applicable FIPS PUBS."

3.2.1.1.2 FIPS PUB 2-1. FIPS PUB 2-1 is a mandatory standard and shall be used to specify the representation of ASCII (FIPS PUB 1-2) on perforated tape used in Federal information processing systems, communications systems and associated equipments.

3.2.1.1.2.1 Applicability. The standard shall be applicable to punched paper tape equipment.

3.2.1.1.2.2 Waivers. Waivers to this standard shall be obtained from the Administrator.

3.2.1.1.2.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Punched paper tape equipment shall be capable of reading and punching in the prescribed ASCII code and format specified in FIPS PUB 1-2 and FIPS PUB 2-1."

3.2.1.1.3 FIPS PUB 3-1. FIPS PUB 3-1 is a mandatory standard and shall be used to specify the recorded characteristics of 9-track one-half inch wide magnetic computer tape, and the data format for implementing ASCII at the recording density of 800 characters per inch (CPI) on magnetic tape media.

3.2.1.1.3.1 Applicability. The standard shall be applicable to all 9-track digital magnetic tape recording equipment employing one-half inch wide tape at a recording density of 800 CPI.

3.2.1.1.3.2 Waivers. Waivers to this standard shall be obtained from the Administrator after coordination with the National Bureau of Standards.

3.2.1.1.3.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All 9-track digital magnetic tape recording and reproducing equipment resulting from this solicitation employing 1/2 inch-wide tape at the recording density of 800 characters per inch (CPI) including associated programs shall provide the capability to accept and generate recorded tapes in compliance with the requirements set forth in FIPS PUB 3-1."

3.2.1.1.4 FIPS PUB 25. FIPS PUB 25 is a mandatory standard and shall be used to specify the recorded characteristics of 9-track, digital one-half inch wide magnetic computer tape, including the data format for implementing the American Standard Code for Information Interchange at the recording density of 1600 CPI.

3.2.1.1.4.1 Applicability. The standard shall be applicable to all 9-track magnetic tape recording and reproducing equipments employing one-half inch wide tape at recording densities of 1600 CPI.

3.2.1.1.4.2 Waivers. Waivers to this standard shall be obtained from the Administrator after coordination with the National Bureau of Standards.

3.2.1.1.4.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All 9-track digital magnetic tape recording and reproducing equipment resulting from this solicitation and employing 1/2-inch wide tape at the recording density of 1600 characters per inch (phase encoded), including associated programs, shall provide the capability to accept and generate recorded tapes in compliance with the requirements set forth in FIPS PUB 25."

3.2.1.1.5 FIPS PUB 50. FIPS PUB 50 is a mandatory standard and shall be used to specify the recorded characteristics of 9-track one-half inch (12.7 mm) wide magnetic computer tape, including the format for implementing the American Standard Code for Information Interchange at the recording density of 6250 CPI (246 characters per millimeter (cpmm)).

3.2.1.1.5.1 Applicability. The standard shall be applicable to all 9-track magnetic tape recording and reproducing equipment employing one-half inch (12.7 mm) wide tape at recording densities of 6250 CPI (246 cpmm).

3.2.1.1.5.2 Waivers: Waivers to this standard shall be obtained from the Administrator after coordination with the National Bureau of Standards.

3.2.1.1.5.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable digital magnetic tape recording and reproducing equipment which results from this solicitation and employs 1/2-inch wide (12.7 mm) magnetic computer tape at the recording density of 6250 characters per inch (246 characters per millimeter) group-coded recording, including associated programs shall provide the capability to accept and generate recorded tape in compliance with the requirements set forth in FIPS PUB 50."

3.2.1.1.6 FIPS PUB 52. FIPS PUB 52 is a mandatory standard and shall be used to specify the recorded characteristics for a 6.30 mm (1/4 in) wide magnetic tape cartridge with either one, two or four serial data tracks in order to provide for data interchange between information processing systems, communication systems, and associated equipment at a recording density of 63 bits per millimeter (1600 bits per inch) using phase encoding techniques.

3.2.1.1.6.1 Applicability. The standard shall be applicable to all magnetic tape cartridge rewording and reproducing equipment.

3.2.1.1.6.2 Waviers. Waivers to this standard shall be obtained from the Administrator.

3.2.1.1.6.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All magnetic tape cartridge recording and reproducing equipment which results from this solicitation and employs 6.30 millimeter (.250 inch) wide magnetic tape with one, two, or four independent serial data tracks at recording densities of 63 bits per millimeter (1600 bits per inch) using phase encoding techniques, including associated software, shall provide the capability to accept and generate recorded magnetic tap cartridges in the code an format as specified in FIPS PUB 1-2 and FIPS PUB 52."

3.2.1.1.7 FIPS PUB 86. FIPS PUB 86 is a mandatory standard and shall be used to specify a set of encoded control functions to facilitate data interchange between ADP/data communication equipment and two-dimensional character-imaging I/O devices. These control functions augment the basic set of control functions prescribed by FIPS PUB 1-2.

3.2.1.1.7.1 Applicability. The standard shall be applicable to all Automated Data Processing (ADP) equipment and services that involve character imaging and which employ the character set and encoding conventions prescribed by FIPS PUB 1-2.

3.2.1.1.7.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the Secretary of Commerce.

3.2.1.1.7.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable ADP character-imaging equipment or services (e.g., interactive ADP terminals of

the display and printer type, line printers, microfilm printers, typesetting composers, word processors, and related devices or services using such devices) offered as a result of the requirements of which this is a part shall comply with the requirements set forth in FIPS PUB 86 when such equipment or services employ the character set and encoding conventions prescribed in FIPS PUB 1-2, employ primarily character-oriented controls, and are consistent with the architectural assumptions for devices in Appendix B, ANSI X3.63-1981. All ADP terminals that meet these conditions are included in this requirement if they contain alphanumeric keyboards and CRT displays or printers that may be used in any form of on-line interactive application or stand-alone off-line data preparation. Computer resident control software may be used, but is not required, to implement specific features of FIPS PUB 86, unless specified otherwise in this document."

3.2.1.2 Transmission.

3.2.1.2.1 FIPS PUB 16-1. FIPS PUB 16-1 is a mandatory standard and shall be used to specify the method of transmitting the Standard Code for Information Interchange. FIPS PUB 16-1 is a joint standard with FED-STD-1010.

3.2.1.2.1.1 Applicability. The standard shall be applicable to equipment or services transmitting an approved Standard Code in a serial-by-bit, serial-by-character stream form at the interface between data terminal equipment and data communications equipment.

3.2.1.2.1.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.1.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable equipment or services that may result from this solicitation, transmitting in a serial-by-bit, serial-by-character mode, shall be capable of bit sequencing as prescribed in FIPS PUB 16-1/FED-STD-1010 for the transmission of the Standard Code for Information Interchange, FIPS PUB 1-2, at the interface between data terminal equipment and data communication equipment."

3.2.1.2.2 FIPS PUB 17-1. FIPS PUB 17-1 is a mandatory standard and shall be used to specify the method of transmitting the Standard Code for Information Interchange, FIPS PUB 1-2, in the serial-by-bit, serial-by-character data transmission. FIPS PUB 17-1 is a joint standard with FED-STD-1011.

3.2.1.2.2.1 Applicability. The standard shall be applicable to equipment or services transmitting an approved Standard Code for Information Interchange (FIPS PUB 1-2) in a serial-by-bit, serial-by-character synchronous or asynchronous mode.

3.2.1.2.2.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.2.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable equipment that may result from this solicitation, transmitting in a serial-by-bit, serial-by-character synchronous or asynchronous mode, shall be capable of transmitting the character structure and sense of character parity

prescribed in FIPS PUB 17-1/FED-STD-1011 for the transmission of the Standard Code for Information Interchange, FIPS PUB 1-2, at the interface between data terminal equipment and data communication equipment."

3.2.1.2.3 FIPS PUB 18-1. FIPS PUB 18-1 is a mandatory standard and shall be used to specify the channel assignment for transmitting the Standard Code for Information interchange, FIPS PUB 1-2, in parallel-by-bit, serial-by-character data transmission. FIPS PUB 18-1 is a joint standard with FED-STD-1012.

3.2.1.2.3.1 Applicability. The standard shall be applicable to equipment or services transmitting an approved Standard Code (FIPS PUB 1-2) in a parallel-by-bit, serial-by-character mode.

3.2.1.2.3.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.3.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable equipment or services that may result from this solicitation, transmitting in a parallel-by-bit, serial-by-character mode, shall be capable of transmitting the character structure and sense of character parity prescribed in FIPS PUB 18-1/FED-STD-1012, when transmitting the Standard Code for Information Interchange, FIPS PUB 1-2, at the interface between data terminal equipment and data communication equipment."

3.2.1.2.4 FIPS PUB 22-1. FIPS PUB 22-1 is a mandatory standard and shall be used to specify the rates of transferring binary encoded information in synchronous serial or parallel form between data processing terminal and data communication equipment that employ voice grade communication facilities. FIPS PUB 22-1 is a joint standard with FED-STD-1013.

3.2.1.2.4.1 Applicability. The standard shall be applicable to equipment and services used in connection with synchronous data communication equipment operating on binary encoded information in serial or parallel fashion over voice grade communication channels of nominal 4 kilohertz (kHz) bandwidth.

3.2.1.2.4.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.4.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable equipment or services resulting from this solicitation that are employed in conjunction with synchronous data communication equipment designed to operate on binary encoded information in either serial or parallel fashion over voice grade communication channels of nominal 4kHz bandwidth shall comply with FIPS PUB 22-1/FED-STD-1013."

3.2.1.2.5 FIPS PUB 37. FIPS PUB 37 is a mandatory standard and shall be used to establish signaling rate requirements for data terminal and data processing equipment which is (1) employed with synchronous data communication equipment

and (2) designed to operate on binary encoded information over wideband communication channels having greater bandwidth than the normal 4kHz bandwidth commonly used in analog voice transmission. FIPS PUB 37 is a joint standard with FED-STD-1001. See Table I for implementation.

3.2.1.2.5.1 Applicability. The standard shall be applicable to all data terminal and data processing equipment employed with synchronous data communication equipment designed to operate on wideband communication channels.

3.2.1.2.5.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.5.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable equipment or services resulting from this solicitation that are employed with synchronous data communication equipment designed to operate on binary coded information over wideband communication channels shall comply with FIPS PUB 37/FED-STD-1001."

3.2.1.2.6 FIPS PUB 71. FIPS PUB 71 is a mandatory standard and shall be used to establish data link control procedures for data processing systems, equipment, and services using synchronous, bit-oriented data communications. FIPS PUB 71 is technically consistent with FED-STD-1003. However, FED-STD-1003 contains additional requirements necessary to ensure interoperability with National Communications Systems (NCS) component networks. FIPS PUB 71 is a joint standard with FED-STD-1003.

3.2.1.2.6.1 Applicability. The standard shall be applicable to the design and procurement of all ADP systems, ADP terminal equipment, and ADP services that are to be employed in computer networking or teleprocessing environments that use bit-oriented synchronous data communication.

3.2.1.2.6.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the Secretary of Commerce.

3.2.1.2.6.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All systems, equipment, and services using synchronous, bit-oriented data communications offered as a result of this requirement shall implement the class(es) of procedures specified in FIPS PUB 71."

3.2.1.2.7 FIPS PUB 100. FIPS PUB 100 is a mandatory standard and shall be used to adopt a subset of the International Telegraph and Telephone Consultative Committee Recommendation X.25 for operating in the Packet Mode on public data networks. FIPS PUB 100 is a joint standard with FED-STD-1041.

3.2.1.2.7.1 Applicability. The standard shall be applicable to the acquisition, design, and development of all federal ADP equipment, services, and telecommunications equipment using public packet/switched data communications networks where an interface based on CCITT Recommendation X.25 is required.

3.2.1.2.7.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.7.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable ADP and Telecommunications equipment or services using public packet/switched data communications network which require an interface based on CCITT Recommendation X.25 shall comply with the requirements specified in FIPS PUB 100/FED-STD-1041."

3.2.1.2.8 FIPS PUB 107. FIPS PUB 107 is a mandatory standard and shall be used to provide the mechanical, electrical, functional and procedural specifications and the link protocol required to establish physical connections, to transmit bits and to send data link frames between nodes.

3.2.1.2.8.1 Applicability. The standard shall be applicable to all Federal departments and agencies which require compatibility with voluntary industry standards for both public and private data communications networks.

3.2.1.2.8.2 Waivers. Waivers to this standard shall be obtained from the Administrator.

3.2.1.2.8.3 Technical requirements portion of the solicitation. The technical requirements portion of the solicitation wording is currently under development.

3.2.1.2.9 FED-STD 1003. FED-STD-1003 is a mandatory standard and shall be used to specify the frame structure, elements of procedure, and classes of procedure for data communications systems that transmit synchronous binary data. FED-STD-1003 is a joint standard with FIPS PUB 71.

3.2.1.2.9.1 Applicability. The standard shall be applicable to the design and procurement of data communications systems and equipment using bit-oriented link control procedures when an agency determines that NCS in operation requirements are needed.

3.2.1.2.9.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.9.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All systems, equipment, and services using synchronous, bit-oriented data communications offered as a result of this requirement shall implement the class(es) of procedures specified in FED-STD-1003."

3.2.1.2.10 FED-STD 1006. FED-STD-1006 is a mandatory standard and shall be used to establish the coding and modulation requirements for 4800 bit/second modems owned or leased by the federal government for use over analog transmission channels.

3.2.1.2.10.1 Applicability. The standard shall be applicable to 4800 bit/second modems (and equipment containing modems) for use with nominal 4kHz analog channels.

3.2.1.2.10.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.10.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All 4800 bit per second modems (and equipment containing 4800 bit per second modems) offered as result of this solicitation for use with nominal 4kHz analog channels shall comply with FED-STD-1006."

3.2.1.2.11 FED-STD-1007. FED-STD-1007 is a mandatory standard and shall be used to establish coding and modulation requirements for duplex 9600 bit/second modems owned or leased by the federal government for use over analog transmission channels terminated by "four-wire" circuits.

3.2.1.2.11.1 Applicability. The standard shall be applicable to duplex 9600 bit/second modems (and equipment containing such modems) for use over nominal 4kHz analog channels terminated by "four-wire" circuits.

3.2.1.2.11.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.11.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All duplex 9600 bit per second modems offered as a result of this solicitation for use with nominal 4kHz analog transmission channels shall comply with FED-STD-1007."

3.2.1.2.12 FED-STD-1008. FED-STD-1008 is a mandatory standard and shall be used to establish coding and modulation requirements for duplex 600 bit/second and 1200 bit/second modems owned or leased by the federal government for use over analog transmission channels terminated by "two-wire" circuits.

3.2.1.2.12.1 Applicability. The standard shall be applicable to duplex 600 bit/second modems and/or 1200 bit/second modems (and equipment containing such modems) for use over nominal 4kHz analog channels terminated by "two-wire" circuits not acoustically coupled to telephone instruments.

3.2.1.2.12.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.12.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All two-wire duplex 600 bit per second and/or 1200 bit per second modems (except those to be acoustically coupled to telephone instruments) offered as a result of this solicitation for use with nominal 4kHz analog channels shall comply with FED-STD-1008."

3.2.1.2.13 FED-STD-1020. FED-STD-1020 is a mandatory standard and shall be used to specify the electrical characteristics of balanced voltage digital interface circuits normally implemented in integrated circuit technology that are to be employed for the interchange of serial binary data, timing, and control signals between voice or data telecommunication equipment where information is being conveyed at the base band level at data signaling rates up to 10 Megabits Per Second (Mb/s).

3.2.1.2.13.1 Applicability. The standard shall be applicable to equipment employing balanced voltage digital interface circuits.

3.2.1.2.13.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.13.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment using balanced voltage digital interface circuits that is offered as a result of this solicitation shall comply with the electrical characteristics addressed by FED-STD-1020."

3.2.1.2.14 FED-STD-1030. FED-STD-1030 is a mandatory standard and shall be used to specify the electrical characteristics of unbalanced voltage digital interface circuits normally implemented in integrated circuit technology that are to be employed for the interchange of serial binary data, timing, and control signals between voice or data telecommunication equipment where information is being conveyed at the baseband level at data signaling rates up to 100 Kilobits Per Second (kb/s).

3.2.1.2.14.1 Applicability. The standard shall be applicable to equipment employing unbalanced voltage digital interface circuits.

3.2.1.2.14.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.14.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment using unbalanced voltage digital interface circuits that is offered as a result of this solicitation shall comply with the electrical characteristics addressed by FED-STD-1030."

3.2.1.2.15 FED-STD-1061. FED-STD-1061 is a mandatory standard and shall be used to establish the machine specifications for Group 2 facsimile apparatus used on voiceband analog circuits.

3.2.1.2.15.1 Applicability. The standard shall be applicable to Group 2 facsimile apparatus for use with voiceband analog circuits.

3.2.1.2.15.2 Waivers. Waivers to the standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.15.3. Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All Group 2 facsimile apparatus offered as a result of this solicitation for use with voiceband analog circuits shall comply with FED-STD-1061."

3.2.1.2.16 FED-STD-1062. FED-STD-1062 is a mandatory standard and shall be used to establish the machine specifications for Group 3 facsimile apparatus used over voiceband analog circuits.

3.2.1.2.16.1 Applicability. The standard shall be applicable to Group 3 facsimile apparatus for use over voiceband analog circuits.

3.2.1.2.16.2. Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.16.3. Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All Group 3 facsimile apparatus designed, developed, or offered for use over voice band analog circuits shall comply with FED-STD-1062."

3.2.1.2.17 FED-STD-1063. FED-STD-1063 is a mandatory standard and shall be used to establish the procedures for document facsimile transmission in the general switched telephone network.

3.2.1.2.17.1. Applicability. The standard shall be applicable to facsimile terminals/systems used in the General Switched Telephone Network.

3.2.1.2.17.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.2.17.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All Group 1, 2 and 3 facsimile apparatus designed, developed, or offered for use over voice band analog circuits shall comply with FED-STD-1063."

3.2.1.3 Documentation.

3.2.1.3.1 FIPS PUB 53. FIPS PUB 53 is a mandatory standard and shall be used to provide a standard magnetic tape transmittal form (SF-277), together with instructions for providing the necessary information on the form.

3.2.1.3.1.1 Applicability. The standard shall be applicable to all Federal information processing operations requiring documentation of the physical properties and characteristics of a recorded magnetic tape file.

3.2.1.3.1.2 Waivers. Waivers to this standard shall be obtained from the Administrator.

3.2.1.3.1.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All magnetic tape used to transmit coded information to the Federal Government as a result of this solicitation shall include completed Standard FORM 277 (SF-277) describing magnetic tape file properties as set forth in FIPS PUB 53."

3.2.1.3.2 FIPS PUB 79. FIPS PUB 79 is a mandatory standard and shall be used to define magnetic tape labels and file structure for information interchange including four levels of labeling, label formats, blocking structure, and tape-mark relationships on magnetically recorded tapes (volumes).

3.2.1.3.2.1 Applicability. The standard shall be applicable to information processing systems using 9-track tape drives for information interchange.

3.2.1.3.2.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the Secretary of Commerce.

3.2.1.3.2.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Information processing systems using nine-track tape drives and new tape label processing facilities that will be part of an information processing system offered as a result of this solicitation shall be capable of generating and processing tape labels and file structures that conform to one of the four levels of FIPS PUB 79 if the information processing system either generates or accepts magnetic tapes for information interchange. Offerors shall specify the level of conformance and certify that a copy of the current users manual is on file with the National Bureau of Standards as required by FIPS PUB 79."

3.2.1.4 Interchange codes, media and data files.

3.2.1.4.1 FIPS PUB 98. FIPS PUB 98 is a mandatory standard and shall be used to facilitate the exchange of electronic messages between different message systems by permitting users of different computer-based message systems to transmit messages to each other.

3.2.1.4.1.1 Applicability. The standard shall be applicable to Computer-Based Message Systems (CBMS). It does not apply to single-processor stand-alone systems which are not interconnected with any other CBMS or systems established strictly for the purpose of supporting research in computer sciences or communications.

3.2.1.4.1.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the Secretary of Commerce.

3.2.1.4.1.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All Computer Based Message Systems and Services in networked systems offered as a result of the requirements of which this is a part shall comply with FIPS PUB 98 unless the requirements document specifies elsewhere that the services are provided by or are systems whose sole purpose is to support research in computer science or communications."

3.2.1.5 General data standards.

3.2.1.5.1 FIPS PUB 58. FIPS PUB 58 is a mandatory standard and shall be used to provide the means for representing the local time of the day based upon both the 12 and 24 hour timekeeping systems for use in the interchange of

information among data systems. It specifies the time elements and their sequencing, the use of separators between time elements and the representation of the meridian designator.

3.2.1.5.1.1 Applicability. The standard shall be applicable to all data systems which must use a coded time representation.

3.2.1.5.1.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the Secretary of Commerce.

3.2.1.5.1.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All data systems requiring the coding of the local time of day shall comply with FIPS PUB 58."

3.2.1.5.2 FIPS PUB 59. FIPS PUB 59 is a mandatory standard and shall be used to provide the means for representing universal time, local time differentials, and United States time zone references to facilitate interchange of data among data systems. It also provides the means whereby local time expressions can be related to universal time or a particular time zone.

3.2.1.5.2.1 Applicability. The standard shall be applicable to all data systems which must use a coded universal time representation.

3.2.1.5.2.2 Waivers. Waivers to this standard shall be obtained from the Administrator.

3.2.1.5.2.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All data systems requiring the coding of universal time, local time differentials, and United States time zone references shall comply with FIPS PUB 59."

3.2.1.5.3 FIPS PUB 81. FIPS PUB 81 is a mandatory standard that defines the modes of operation that shall be used with the Federal Data Encryption Standard described in FIPS PUB 46. These modes specify how sensitive computer data will be encrypted (cryptographically protected) and decrypted (returned to original form).

3.2.1.5.3.1 Applicability. The standard shall be applicable to equipment and services and requires compliance with FIPS PUB 46.

3.2.1.5.3.2 Waivers. Waivers to this standard shall be obtained from the Administrator.

3.2.1.5.3.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Equipment and services offered as a result of this solicitation that implement the Data Encryption Standard (FIPS PUB 46) and that are intended for use in the cryptographic protection of sensitive but unclassified computer data shall use one or more of the modes of operation specified in FIPS PUB 81."

3.2.1.5.4 FED-STD-1002. FED-STD-1002 is a mandatory standard and shall be used to establish the requirements for telecommunication facilities and systems of the federal government to utilize time and frequency reference information based upon Coordinated Universal Time (UTC).

3.2.1.5.4.1 Applicability. The standard shall be applicable to telecommunication facilities and systems dependent on time or frequency reference information.

3.2.1.5.4.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.5.4.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All applicable telecommunication facilities and systems that are offered or used as a result of this solicitation shall be referenced to the time and frequency standard specified in FED-STD-1002."

3.2.1.5.5 FED-STD-1005. FED-STD-1005 is a mandatory standard and shall be used to establish the coding and modulation requirements for 2400 bit/second modems owned or leased by the federal government for use over analog transmission channels other than those derived from high-frequency radio facilities.

3.2.1.5.5.1 Applicability. The standard shall be applicable to 2400 bit/second modems for use with nominal 4kHz channels derived from either switched networks or dedicated lines. It provides for split channel (full duplex) operation on switched circuits.

3.2.1.5.5.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.5.5.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All 2400 bit per second modems that are offered as a result of this solicitation for use with 4kHz channels derived from either switched networks or dedicated lines shall comply with FED-STD-1005."

3.2.1.5.6 FED-STD-1026. FED-STD-1026 is a mandatory standard and shall be used to facilitate the interoperation of government data communication facilities, systems, and data that require cryptographic protection using the Data Encryption Standard algorithm. The standard specifies interoperability and security related requirements using encryption at the Physical Layer of the ISO Open Systems Interconnection Basic Reference Model (ISO 7498) in the telecommunication systems conveying Automatic Data Processing (ADP) and/or narrative text information.

3.2.1.5.6.1 Applicability. The standard shall be applicable to all Data Encryption Standard cryptographic components, equipment or services used for encryption of ADP and/or narrative text information in the Physical Layer data communications using the Data Encryption Standard algorithm.

3.2.1.5.6.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Service Administration.

3.2.1.5.6.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All telecommunications equipment and systems used by the departments and agencies of the U.S. Government shall comply with the security requirements for the implementation of the Data Encryption Standard as addressed by FED-STD-1026."

3.2.1.5.7 FED-STD-1027. FED-STD-1027 is a mandatory standard and shall be used to prescribe security requirements for implementation of the Data Encryption Standard in telecommunication equipment and systems used by the departments and agencies of the U.S. Government.

3.2.1.5.7.1 Applicability. The standard shall be applicable to DES cryptographic components, equipment, systems, and services procured by the U.S. Government for the encryption of digital information in the telecommunications environment. Agency heads or their designees shall refer to NCSC-11, the "National Policy for Protection of Telecommunications Systems Handling Unclassified National Security - Related Information," in determining whether to require the use of this standard.

3.2.1.5.7.2 Waivers. Waivers to this standard shall be obtained by the Administrator from the General Services Administration.

3.2.1.5.7.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "If a requirement for the encryption protection of unclassified digital information in the telecommunications environment is specified elsewhere in this requirements document, all cryptographic components, equipment, systems, and services offered to meet that requirement shall comply with FED-STD-1027 and be endorsed as so complying by the National Security Agency prior to being proposed. These items include stand alone DES cryptographic equipment as well as any data terminal equipment and data circuit-terminating equipment utilizing the DES algorithm (described in FIPS PUB 46) for digital encryption. Arrangements for endorsement shall be made with the communications Protection Special Project Office (S93), National Security Agency, 9800 Savage Road, Fort George G. Meade, MD 20755."

3.2.1.6 International (Treaty).

3.2.1.6.1 International Telegraph Alphabet Number 2 (ITA-2). ITA-2 is defined in ICAO Annex 10, Volume 1. It shall be used to establish the 5-unit interchange code for low speed asynchronous applications for international aviation applications. The approved code and character font assignments, as well as unauthorized combinations for international use are specified.

3.2.1.6.1.1 Applicability. The standard shall be applicable to all teletypewriter equipment and systems used in the low speed portions of the Aeronautical Fixed Telecommunications Network (AFTN) where 5-unit code is used for data communications. This code set shall only be used if International Alphabet Number 5 (IA-5) cannot be implemented.

3.2.1.6.1.2 Waivers. Waivers to this standard shall be obtained from ADL-1. When used in international applications any waiver shall be negotiated and documented in a bilateral agreement, as well as filed with ICAO as an exception to Annex 10.

3.2.1.6.1.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "The system or equipment shall receive and transmit characters in the format prescribed for 5-unit code (ITA-2) in paragraph 4.2.1 of ICAO Annex 10, Volume 1 for information interchange."

3.2.1.6.2 International Alphabet Number 5 (IA-5). IA-5 is defined in ICAO Annex 10, Volume 1, paragraph 4.12.1.1. It shall be used to establish the 7-unit coded character set for information interchange for international applications. The approved code and font assignments, as well as notes, rules, and functional characteristics are provided.

3.2.1.6.2.1 Applicability. The standard shall be applicable to all equipment and systems used in the Aeronautical Fixed Telecommunications Network where 7-unit code is used for information interchange.

3.2.1.6.2.2 Waivers. Waivers to this standard shall be obtained from ADL-1. When used in international applications any waiver shall be negotiated and documented in a bilateral agreement, as well as filed with ICAO as an exception to Annex 10.

3.2.1.6.2.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "The equipment or system shall transmit and receive in the format prescribed for 7-unit code (IA-5) of ICAO in paragraph 4.12.1.1 of Annex 10, Volume 1, for information interchange."

3.2.1.6.3 Code conversion. Code Conversion is defined in ICAO Annex 10, Volume 1, paragraphs 4.12.1.2.4 and 4.12.1.2.5. It shall be used to provide the capability to do character for character and sequence conversions between the 5-unit and 7-unit code sets used for international applications. The use of this standard eliminates the incompatibilities that can arise when a network is comprised of equipment and users who need to exchange information and are using both code sets.

3.2.1.6.3.1 Applicability. The standard shall be applicable when conversion between ITA-2 and IA-5 for international information interchange is required.

3.2.1.6.3.2 Waivers. Waivers to this standard shall be obtained from ADL-1. When used in international applications any waivers shall be negotiated and documented in a bilateral agreement, as well as filed with ICAO as an exception to Annex 10.

3.2.1.6.3.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Code conversion between equipment and systems employing the 5-unit and 7-unit code sets of ICAO shall be in accordance with paragraphs 4.12.1.2.4 and 4.12.1.2.5 and the referenced code tables of Annex 10, Volume I."

3.2.1.6.4 System Category A (CAT A) Character Oriented Link Control. System Category A is defined in ICAO Annex 10, Volume 1. It shall be used to specify a two-way alternate, multipoint link protocol allowing either centralized or decentralized operation, and either single or multiple message-oriented information transfers without replies, but with delivery verification. This standard is designed for computer-computer and computer-terminal multipoint applications.

3.2.1.6.4.1 Applicability. The standard shall be applicable for information transfer between computers or terminals in multipoint configurations, when the IA-5 or ASCII (FIPS PUB 1-2) is used, and the use of a bit-oriented protocol such as High Level Data Link Control Procedures (HDLC) cannot be implemented.

3.2.1.6.4.2 Waivers. Waivers to this standard shall be obtained from ADL-1. When used in international applications any waivers shall be negotiated and documented in a bilateral agreement, as well as filed with ICAO as an exception to Annex 10.

3.2.1.6.4.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Data terminal, line controller, and related equipment that supports the link control procedure for System Category A shall do so in accordance with the relevant portions of paragraph 4.12.4.5 and Attachment H to Part 1 of Annex 10, Volume 1."

3.2.1.6.5 System Category B (CAT B) Character Oriented Link Control. System Category B is defined in ICAO Annex 10, Volume 1. It shall be used to specify a two-way simultaneous, point to point protocol employing message associated blocking and modulo 8 numbering of blocks and acknowledgments .

3.2.1.6.5.1 Applicability. The document shall be applicable for information transfer between computers for point to point configurations, when the IA-5 or ASCII (FIPS PUB 1-2) is used, and a bit-oriented (e.g. HDLC) protocol cannot be implemented.

3.2.1.6.5.2 Waivers. Waivers to this standard shall be obtained from ADL-1. When used in international applications any waivers must be negotiated and documented in a bilateral agreement, as well as filed with ICAO as an exception to Annex 10.

3.2.1.6.5.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Data terminal, line controller, and related equipment that supports the link control procedure for System Category B shall do so in accordance with the relevant portions of paragraph 4.12.4.6 and Attachment H to Part 1 of Annex 10, Volume 1."

3.2.1.6.6 System Category C (CAT C) Character Oriented Link Control. System Category C is defined in ICAO Annex 10, Volume 1. It shall be used to specify a two-way alternate, multipoint protocol allowing only centralized (computer to/from terminal) operation, and single or multiple message transfers, with replies.

3.2.1.6.6.1 Applicability. The standard shall be applicable to information transfer between a computer and terminals for multipoint configuration, when the IA-5 or ASCII (FIPS PUB 1-2) is used, and a bit-oriented (HDLC) protocol cannot be implemented.

3.2.1.6.6.2 Waivers. Waivers to this standard shall be obtained from ADL-1. When used in international applications any waivers must be negotiated and documented in a bilateral agreement, as well as filed with ICAO as an exception to Annex 10.

3.2.1.6.6.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Data terminal, line controller, and related equipment that supports the link control procedure for System Category C shall do so in accordance with the relevant portions of paragraph 4.12.4.7 and Attachment H to Part 1 of Annex 10, Volume 1."

3.2.1.6.7 High-Level Data Link Control Procedures. The HDLC procedures in ICAO document Annex 10, Volume 1, is a mandatory standard and shall be used to specify a link control protocol that may be implemented in a multipoint Normal Response Mode (NRM), a functional point to point Asynchronous Response Mode (ARM) or a point to point Asynchronous Balanced Mode (ABM) of operation. It provides for bit-oriented operation that allows any character structured code or bit stream data to be transferred.

3.2.1.6.7.1 Applicability. The document shall be applicable to synchronous information transfer (2400 bits per second and higher) between computers, or computers and terminals, in multipoint or point to point configurations, whereby the protocol is independent from the structure of the information being transferred. The ICAO implementation of this standard is the same as that specified by the International Organization for Standardization and allows interoperation with systems employing that standard.

3.2.1.6.7.2 Waivers. Waivers to this standard shall be obtained from ADL-1. In international applications any waiver shall be negotiated and documented as a bilateral agreement, as well as filed with ICAO as an exception to Annex 10, Volume I.

3.2.1.6.7.3 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Data terminal, line controller, and related computer equipment that supports HDLC procedures shall be in accordance with paragraph 4.12.3 and Attachment G to Part 1, of Annex 10, Volume 1."

3.3 Analog voice and data transmission characteristics and selection. This subsection describes in summary form the features or parameters of these selected standards.

3.3.1 Parameters and selection criteria.

3.3.1.1 Data communication.

3.3.1.1.1 Publication (PUB) 41008. PUB 41008 is a voluntary document and shall be used to describe analog parameters which may affect data transmission over voiceband channels.

3.3.1.1.1.1 Applicability. This publication is used as a basis for engineering evaluations to establish data transmission technical requirements for customer provided data transmission equipment.

3.3.1.1.1.2 Technical requirements portion of the solicitation. The following wording is used in the Solicitation: "All transmission technical requirements, for customer provided data transmission equipment shall comply with PUB 41008."

3.3.1.1.2 IEEE-STD 783-1984. IEEE-STD 783-1984 is a voluntary document and shall be used to outline general techniques in measuring transmission characteristics of telephone channels.

3.3.1.1.2.1 Applicability. This publication is used to define the engineering analysis procedure to determine viable customer provided data transmission test sets.

3.3.1.1.2.2 Technical requirements portion of the solicitation. The following wording is used in the Solicitation: "Telephone channels shall have transmission characteristics measured in compliance with IEEE-STD 783-1984."

3.3.1.2 Transmission engineering.

3.3.1.2.1 PUB 41011. PUB 41011 is a voluntary document and shall be used to provide information on the voice grade private line channel specifically designed for power industry audio tone protective relaying applications.

3.3.1.2.1.1 Applicability. This publication is applicable to private line channels used for analog tone signaling.

3.3.1.2.1.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Any voice grade private line channels which are used for audio tone protection relaying applications shall comply with PUB 41011."

3.3.1.2.2 PUB 43002. PUB 43002 is a voluntary document and shall be used to state the minimal criteria necessary to determine whether voice frequency transmission and signaling equipment for metallic facilities is suitable for use on customer premises.

3.3.1.2.2.1 Applicability. This publication is applicable to any voice transmission or signaling equipment that is intended to interface with leased facilities.

3.3.1.2.2.2 Solicitation. The following wording is used in the solicitation: "All voice frequency transmission and signaling equipment for metallic facilities shall comply with PUB 43002."

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3.3.1.2.3 PUB 43003. PUB 43003 is a voluntary document and shall be used to provide requirements and objectives for a 2-wire maintenance terminating unit for voice frequency special services.

3.3.1.2.3.1 Applicability. This publication is applicable to automated maintenance procedures and built-in test equipment on customer provided hardware that interfaces leased voice frequency transmission facilities.

3.3.1.2.3.2 Technical requirements portion of the solicitation. The following wording is used in the solicitation: "All 2-wire maintenance terminating units for voice frequency special services shall comply with PUB 43003."

3.3.1.3 Private line facilities.

3.3.1.3.1 PUB 43301. PUB 43301 is a voluntary document and shall be used as a guide for designers, manufacturers and users of customer provided mobile terminals to assure compatibility with Bell System or other Public Land Mobile Radio Service.

3.3.1.3.1.1 Applicability. This publication is applicable to dial-up links to mobile phones from a Private Branch Exchange (PBX).

3.3.1.3.1.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All mobile phones or mobile terminals shall comply with PUB 43301."

3.3.1.3.2 PUB 43004. PUB 43004 is a voluntary document and shall be used to state requirements and objectives for a 4-wire maintenance terminating unit for voice frequency special services.

3.3.1.3.2.1 Applicability. This publication is applicable to automated maintenance procedures and built-in test equipment on customer provided hardware that interfaces leased voice frequency transmission facilities.

3.3.1.3.2.2 Technical requirements portion of the solicitation. The following wording is used in the solicitation: "All 4-wire maintenance terminating units for voice frequency special services shall comply with PUB 43004."

3.3.1.3.3 PUB 43005. PUB 43005 is a voluntary document and shall be used to provide the parameters of an impedance compensator with gain to meet terminal balance requirements at the customer end of a 2-wire PBX trunk.

3.3.1.3.3.1 Applicability. This publication is applicable to interfaces with 2-wire PBX trunks.

3.3.1.3.3.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All impedance compensators with gain which meet terminal balance requirements at the customer end of a 2-wire PBX trunk shall comply with PUB 43005."

3.3.1.3.4 PUB 43101. PUB 43101 is a voluntary document and shall be used to describe the various entrance facility serving arrangements, provides transmission characteristics of entrance facilities, describes signal power limitations and discusses the division of responsibility for design, operation and maintenance.

3.3.1.3.4.1 Applicability. This publication is applicable to voice grade customer communications channels.

3.3.1.3.4.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Equipment interfacing to entrance facilities shall comply with PUB 43101."

3.3.1.3.5 PUB 43201. PUB 43201 is a voluntary document and shall be used to describe the standard private line offerings for voice applications which may be interconnected at one or both ends with customer-provided voice communications systems or terminal equipment. It also describes minimum protection criteria, signaling arrangements and maintenance techniques.

3.3.1.3.5.1 Applicability. These publications are applicable to standard private line offerings for wire applications which may be interconnected with customer-provided voice communications systems and terminal equipment.

3.3.1.3.5.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Voice communications systems or terminal equipment connecting to private line offerings for wire applications shall comply with PUB 43201."

3.3.1.3.6 PUB 43401. PUB 43401 is a voluntary document and shall be used to describe the signal level criteria objective for private line metallic circuits (cable pairs without signal battery or amplification devices).

3.3.1.3.6.1 Applicability. This publication is applicable to leased services from AT&T and other common carriers.

3.3.1.3.6.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All customer provided equipment interfacing to private line metallic circuits shall comply with PUB 43401."

3.3.1.3.7 PUB 43701. PUB 43701 is a voluntary document and shall be used to supply information concerning the technical parameters of leased private line services, and shall serve as both a design and ordering aid to the customer.

3.3.1.3.7.1 Applicability. This publication is applicable to interface between communications channels and private lines.

3.3.1.3.7.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing with leased private line services shall comply with PUB 43701."

3.3.1.3.8 PUB 43720. PUB 43720 is a voluntary document and shall be used to describe the technical content and use of the compatibility checklists which describe certain characteristics of a carrier's switch termination including the type of outpulsing control that can be provided (delay dial, wink start, dial tone), the type of addressing that can be generated outgoing and accepted incoming (TOUCH-TONE or Dial Pulse), and the maximum number of digits that can be outpulsed.

3.3.1.3.8.1 Applicability. This publication is applicable to the specification of compatibility checklists.

3.3.1.3.8.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Equipment interfacing to a carrier's switch terminations shall comply with PUB 43720."

3.3.1.4 Digital transmission systems.

3.3.1.4.1 PUB 43802. PUB 43802 is a voluntary document and shall be used to identify requirements and objectives that should be met to insure satisfactory operation of digital multiplexes including the M1C, M12, M13, and M34 multiplexes plus the MC3, M13, and M23 options of the MX3 multiplex.

3.3.1.4.1.1 Applicability. This publication is applicable to digital multiplexers.

3.3.1.4.1.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "Digital multiplexers including the M1C, M12, M13, and M34 shall comply with PUB 43802."

3.3.1.4.2 PUB 43803. PUB 43803 is a voluntary document and shall be used to describe facility maintenance features required for interoffice digital transmission systems, giving manufacturers of interoffice digital equipment the detailed requirements needed to incorporate maintenance features into the equipment that they manufacture.

3.3.1.4.2.1 Applicability. This publication is applicable to engineering assessments of communications network automated maintenance requirements for digital transmission systems.

3.3.1.4.2.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All interoffice digital transmission systems shall have maintenance features in compliance with PUB 43803."

3.3.1.4.3 PUB 43804. PUB 43804 is a voluntary document and shall be used to provide suppliers of the Network Terminal Equipment (NTE) and operations systems with the information necessary to follow the telephone companies standards on the NTE operations interfaces and with guidelines needed to interface NTEs with the RC operations system.

3.3.1.4.3.1 Applicability. This publication is applicable to network terminal equipment operations interfaces.

3.3.1.4.3.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation. "All network terminal equipment shall comply with PUB 43804."

3.3.1.4.4 PUB 43806. PUB 43806 is a voluntary document and shall be used to provide requirements and objectives for lightwave digital transmission systems intended for use between central offices within metropolitan areas. It covers systems using multimode technology, including wavelength division multiplexing but not single-mode technology.

3.3.1.4.4.1 Applicability. This publication is applicable to customer provided electro-optical conversion and transmission equipment intended for interface with leased optical transmission lines.

3.3.1.4.4.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All lightwave digital transmission systems intended for interface to central offices shall comply with PUB 43806."

3.3.1.5 General type testing.

3.3.1.5.1 PUB 61310. PUB 61310 is a voluntary document and shall be used to describe the network access interface specifications to a circuit switched digital capability for the digital transmission of data at 56 kilobits per second and alternately, the transmission of analog voice signals.

3.3.1.5.1.1 Applicability. This publication is applicable to multiplexed analog voice, encrypted analog voice and high speed digital equipment interface requirements for customer provided equipment to interface leased wideband circuits.

3.3.1.5.1.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to the circuit switched digital capability shall comply with PUB 61310."

3.3.1.6 Private line channel network compatibility and performance specifications.

3.3.1.6.1 PUB 62103. PUB 62103 is a voluntary document and shall be used to provide design rules and requirements for High Performance Data Conditioning (HPDC) Type D5 conditioning on Multi-Point Private Line (3002-Type) voice grade data channels.

3.3.1.6.1.1 Applicability. This publication is applicable to multi-point private line (3002-Type) voice grade data channels with HPDC-Type D5 conditioning.

3.3.1.6.1.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All circuits and equipment interfacing with multi-point private line (3002-Type) voice grade data channels with HPDC-Type D5 conditioning shall comply with PUB 62103."

3.3.1.6.2 PUB 62200. PUB 62200 is a voluntary document and shall be used to provide customer interface and transmission specifications for Group (60-108 kHz) and Super group (312-552 kHz) service offerings.

3.3.1.6.2.1 Applicability. This publication is applicable to multiplex interfaces and equipment transmission requirements for customer provided equipment intended for interface to carrier private line networks.

3.3.1.6.2.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to Group (60-108 kHz) and Super group (312-552 kHz) service offerings shall comply with PUB 62200."

3.3.1.6.3 PUB 62310. PUB 62310 is a voluntary document and shall be used to describe the Digital Data System (DDS) interface to the customer's data terminal equipment, covering performance objectives, testing and maintenance considerations, DDS loop makeup and requirements, signal characteristics and customer provided equipment requirements.

3.3.1.6.3.1 Applicability. This publication is applicable to interfaces between customer provided equipment and the DDS.

3.3.1.6.3.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All data terminal equipment interfacing to the Digital Data System (DDS) shall comply with PUB 62310."

3.3.1.6.4 PUB 62411. PUB 62411 is a voluntary document and shall be used to define the electrical and physical parameters at the Network Interface (NI) to comply with FCC Docket 81-216 which permits compatible operation of customer provided digital terminating equipment with High Capacity Digital Service (HCDS).

3.3.1.6.4.1 Applicability. This publication is applicable to HCDS network interfaces.

3.3.1.6.4.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment terminating at the network interface shall comply with PUB 62411."

3.3.1.6.5 PUB 62500. PUB 62500 is a voluntary document and shall be used to describe Switched Access Services (SAS) provided to the Interlocal Access and Transport Area Carrier by the local carrier.

3.3.1.6.5.1 Applicability. This publication is applicable to interface with the switched access services system.

3.3.1.6.5.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to Switched Access Services (SAS) shall comply with PUB 62500."

3.3.1.6.6 PUB 62501. PUB 62501 is a voluntary document and shall be used to describe the 13 voice grade and dedicated access lines special services in technical detail to allow each service to be incorporated into an end-to-end Interlocal Access and Transport Area Carrier offering.

3.3.1.6.6.1 Applicability. This publication is applicable to services provided on dedicated access lines by common carrier.

3.3.1.6.6.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to voice grade and dedicated access lines special services shall comply with PUB 62501."

3.3.1.6.7 PUB 62502. PUB 62502 is a voluntary document and shall be used to define the Narrowband Special Access Services distinguishing service features, technical specifications and valid interfaces offered by the Telephone Companies to the Interlocal Access and Transport Area Carrier.

3.3.1.6.7.1 Applicability. This publication is applicable to the determination of the compatibility of services available to customer provided voice and data transmission systems.

3.3.1.6.7.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to Narrowband Special Access Services shall comply with PUB 62502."

3.3.1.6.8 PUB 62503. PUB 62503 is a voluntary document and shall be used to describe the Program Audio Special Access Services distinguishing service features, technical specifications and valid interfaces offered by the Telephone Companies to the Interlocal Access and Transport Area Carrier.

3.3.1.6.8.1 Applicability. This publication is applicable to determine the compatibility of services available to customer provided voice and data systems.

3.3.1.6.8.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to the Program Audio Special Access Services shall comply with PUB 62503."

3.3.1.6.9 PUB 62504. PUB 62504 is a voluntary document and shall be used to describe the Television Special Access Services' distinguishing service features, technical specifications and valid interfaces offered by the Telephone Companies to the Interlocal Access and Transport Area Carrier.

3.3.1.6.9.1 Applicability. This publication is applicable to determining the compatibility of services available to customer video transmission systems.

3.3.1.6.9.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to the Television Access Service shall comply with PUB 62504."

3.3.1.6.10 PUB 62505. PUB 62505 is a voluntary document and shall be used to detail the Wideband Analog Special Access Services' distinguishing features, technical specifications and valid interfaces offered by the Telephone Companies to the Interlocal Access and Transport Area Carrier.

3.3.1.6.10.1 Applicability. This publication is applicable to the determination of the compatibility of services available to customer voice and data transmission systems.

3.3.1.6.10.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to the Wideband Analog Special Access Service shall comply with PUB 62505."

3.3.1.6.11 PUB 62506. PUB 62506 is a voluntary document and shall be used to describe the Wideband Digital Special Access Services' distinguishing service features, technical specifications and valid interfaces offered by carriers to the Interlocal Access and Transport Area Carrier.

3.3.1.6.11.1 Applicability. This publication is applicable to the determination of the compatibility of services available to customer provided voice and data transmission systems.

3.3.1.6.11.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to the Wideband Digital Special Access Service shall comply with PUB 62506."

3.3.1.6.12 PUB 62507. PUB 62507 is a voluntary document and shall be used to describe the Digital Data Special Access Services' distinguishing service features, technical specifications and valid interfaces offered by the Telephone Companies to the Interlocal Access and Transport Area Carrier.

3.3.1.6.12.1 Applicability. This publication is applicable to high speed multiplex channels and customer provided equipment interface channels.

3.3.1.6.12.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to the Digital Data Special Access Service shall comply with PUB 62507."

3.3.1.6.13 PUB 62113. PUB 62113 is a voluntary document and shall be used to interface to private line off-premises station lines that accommodate Registered Terminal Equipment having facility interface codes 0L13A, 0L13B and 0L13C.

3.3.1.6.13.1 Applicability. This publication is applicable to customer provided remote telephone stations that will interface customer owned PBXs or leased lines.

3.3.1.6.13.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All registered terminal equipment having facility interface codes OLL3A, OLL3B, and OLL3C which interface to private line off-premises station lines shall comply with PUB 62113."

3.3.1.6.14 PUB 62114. PUB 62114 is a voluntary document and shall be used to describe the interface to private line tie trunks that accommodate Four Wire Lossless, Type I and Type II E and M Connections (M-Lead Originates).

3.3.1.6.14.1 Applicability. This publication is applicable to interface customer provided equipment to PBX tie trunks.

3.3.1.6.14.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to private line tie trunks that accommodate four-wire lossless, Type I and Type II E and M connections (M-Lead Originates) shall comply with PUB 62114."

3.3.1.6.15 PUB 62115. PUB 62115 is a voluntary document and shall be used to describe the interface to private line tie trunks that accommodate Four Wire Lossless, Type I and Type II E and M Connections (E-Lead Originates).

3.3.1.6.15.1 Applicability. This publication is applicable to interfacing customer provided equipment to PBX tie trunks.

3.3.1.6.15.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to private line tie trunks that accommodate four-wire lossless, Type I and Type II E and M Connections (E-Lead originates) shall comply with PUB 62115."

3.3.1.6.16 PUB 62508. PUB 62508 is a voluntary document and shall be used to define High Capacity Digital Access Services' distinguishing service features, technical specifications and valid interfaces offered by the Telephone Companies to the Interlocal Access and Transport Area Carrier.

3.3.1.6.16.1 Applicability. This publication is applicable to equipment interfacing the High Capacity Digital Access Service.

3.3.1.6.16.2 Technical requirements portion of the solicitation. The following wording shall be used in the solicitation: "All equipment interfacing to the High Capacity Digital Access Service shall comply with PUB 62508."

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4. QUALITY ASSURANCE PROVISIONS

This section is not applicable to this standard.

5. PREPARATION FOR DELIVERY

This section is not applicable to this standard.

6. NOTES

6.1 Definitions.

6.2 Acronyms and abbreviations. The following are definitions of acronyms and abbreviations used in this standard.

ABM	Asynchronous Balanced Mode
ADCCP	Advanced Data Communication Control Procedures
ADL-1	Associate Administrator for Development and Logistics
ADP	Automatic Data Processing
ADTN	Administrative Data Telecommunication Network
AFTN	Aeronautical Fixed Telecommunications Network
ANSI	American National Standards Institute
ARM	Asynchronous Response Mode
ASCII	American Standard Code for Information Interchange
AT&T	American Telephone and Telegraph
BAL	Balanced
BCC	Block Check Character
BOC	Bell Operating Company
bpi	Bits per inch
bpmm	Bits per millimeter

BSC	Binary Synchronous
Byte	Block of eight bits of data
b/s	Bits per second
CAT 1	Category 1
CAT 2	Category 2
CAT A	System Category A
CAT B	System Category B
CAT C	System Category C
CBMS	Computer-Based Message System
CCITT	International Telephone and Telegraph Consultive Committee
CKTS	Circuits
CMD	Command
CNTRL	Control
CPE	Customer provided equipment
CPI	Characters per inch
cpm	Characters per millimeter
CRC-16	Cyclic Redundancy Check, 16 bit
CRC-32	Cyclic Redundancy Check, 32 bit
CRT	Cathode Ray Tube
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
D-bit	Delivery Confirmation Bit
DC	Device Control
DCA	Defense Communications Agency
DCE	Data Circuit-Terminating Equipment
DDN	Defense Digital Network

DDS	Digital Data System
DEL	Delivery
DES	Data Encryption Standard
DIS	Draft International Standard
DP	Draft Proposal
DTE	Data Terminal Equipment
EIA	Electronic Industry Association
EXT	Extension
EXTD	Extended
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FED-STD	Federal Standard
FEP	Front End Processor
FIPS PUB	Federal Information Processing Standard Publication
FIRMR	Federal Information Resources Management Regulation
GSA	General Services Administration
HCDS	High Capacity Digital Service
HDLC	High Level Data Link Control Procedures
HPDC	High-Performance Data Conditioning
I	Information
IA-5	International Alphabet Number 5

ICAO	International Civil Aviation Organization
ICST	Institute for Computer Sciences and Technology
IEEE	Institute of Electrical Electronic Engineers
IM	Initialization Mode
I/O	Input/Output
ISO	International Organization for Standardization
ISSN	Integrated Special Service Network
ITA-2	International Telegraph Alphabet Number 2
k	Kilo
kb/s	Kilobits per second
kHz	Kilohertz
LAN	Local Area Network
LLC	Logical Link Control
MA	Message-Associated
Mb/s	Megabits per second
mm	millimeter
MO	Message oriented
MTS	Message Telecommunications Service
NADIN	National Airspace Data Interchange Network
NAK	Negative Acknowledgment
NAS	National Airspace System
NBS	National Bureau of Standards
NCS	National Communications Systems
NCSC	National Communications Security Committee
NI	Network Interface

NR	Not Required
NRM	Normal Response Mode
NRZI	Non-Return to Zero Inverted
NTE	Network Terminal Equipment
OCC	Other Common Carrier
OSI	Open Systems Interconnection
PAD	Packet Assembly/Disassembly
PBX	Private Branch Exchange
PDN	Public Data Networks
PM	Packet Mode
PSN	Packet Switched Network
PSTN	Public Switched Telephone Network
PUB	Publication
PVC	Permanent Virtual Circuit
RC	Regional Company
RD	Request Disconnect
RECMD	Recommended
REJ	Reject
RES	Response
RIM	Request Initialization Mode
RPOA	Recognized Private Operating Administration
RSET	Reset
SABME	Set Asynchronous Balanced Mode, Extended
SARME	Set Asynchronous Response Mode, Extended

SAS	Switched Access Services
SF-277	Standard Form 277
SIM	Set Initialization Mode
SNRME	Set Normal Response Mode, Extended
SREJ	Selective Reject
SW	Switched
S/S	Start/Stop
TBD	To Be Determined
TEMP. REG.	Temporary Register
UI	Unnumbered Information
UNBAL	Unbalanced
UP	Unnumbered Poll
US	United States
UTC	Coordinated Universal Time
VC	Virtual Circuit/Call
VDC	Volts, Direct Current
WATS	Wide-Area Telecommunications Service
XID	Exchange Identification

APPENDIX I

10. DATA TRANSFER STANDARDS SELECTION

10.1 SCOPE

10.1.1 Scope. This appendix contains, in summary form, a description of the features and parameters of the data standards. Selection criteria is included where appropriate.

10.1.2 Purpose. This Appendix presents data transfer standards and is arranged in a manner consistent with the ISO OSI 7-layer model. A general diagrammatic tree is provided in Figure 1. Technical characteristics of the data standards are noted as necessary.

10.2 APPLICABLE DOCUMENTS

10.2.1 Government documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this appendix to the extent specified herein.

STANDARDS:

Federal

FIPS PUB 78

Guidelines for
Implementing ADCCP

Other Publications:

FAA Order 1830.1

Access Policy for Non-FAA
Users Into Tele-
communications Systems
and Circuits Funded by FAA

Copies of specifications, standards, drawings, and publications required by suppliers in connection with specified procurement functions should be obtained from the procuring activity or as directed by the contracting officer.

10.2.2 Non-Government documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this appendix to the extent specified herein.

OTHER PUBLICATIONS:

American National Standards Insititute (ANSI)

X3.32-1973

Graphic Representation of
the Control Characters of
American National
Standard Code for
Information Interchange

X3.41-1974

Code Extension Techniques
for Use with the 7-Bit
Coded Character Set of
American National
Standard Code for
Information Exchange

Electronic Industries Association (EIA)

Bulletin 12

Application Notes on
Interconnection Between
Interface Circuits Using
RS-449

RS-232

Interface Between Data
Terminal Equipment and
Data Communication
Equipment Employing
Serial Binary Data
Interchange

RS-366

Interface Between DTE and
Automatic Calling
Equipment for Data
Communication

RS-422

Electrical
Characteristics of
Balanced Voltage Digital
Interface Circuits

RS-423

Electrical
Characteristics of
Unbalanced Voltage
Digital Interface Circuits

RS-449

General Purpose
37-position and
9-position Interface
Between Data Terminal
Equipment and Data
Circuit Terminating
Equipment

RS-496

Interface Between Data
Circuit Equipment (DCE)
and the Public Switched
Telephone Network (PSTN)

Institute of Electrical and Electronic Engineers (IEEE)

802.2

Logical Link Control (LLC)

802.3

Local Networks - CSMA/CD

802.4

Local Networks - Token Bus

802.5

Local Networks - Token
Ring

International Organization for Standardization (ISO)

ISO/DIS 8072

Transport Service
Standard

ISO 8073

Information Processing
Systems - Open Systems
Interconnection -
Connection - Oriented
Transport Protocol
Specifications

ISO/DIS 8326

Basic Connection-Oriented
Session Service Definition

ISO/DIS 8327

Basic Connection-Oriented
Session Protocol
Specification

ISO/DIS 8473

Protocol for Providing
the Connection-less Mode
Network Service

International Telegraph and Telephone Consultative Committee (CCITT)

Recommendation X.1

International User
Classes of Service in
Public Data Networks (PDN)

Recommendation X.2

International User
Facilities in Public Data
Networks

Recommendation X.3

Packet
Assembly/Disassembly
Interface for
Asynchronous Terminals

Recommendation X.21

Interface Between Data
Terminal Equipment (DTE)
and Data Circuit -
Terminating Equipment
(DTE) for Synchronous
Operation on Public Data
Networks.

Recommendation X.28

DTE/DCE Interface for
Start/Stop Mode Data
Terminal Equipment
Accessing the Packet
Assembly/Disassembly
Facility (PAD) on a
Public Network Switched
in the Same Country

Recommendation X.29

Procedures For Exchange
of Control Information
and User Data Between a
Packet Mode DTE and A
Packet Assembly/
Disassembly Facility (PAD)

Recommendation X.32

Interface between Data
Terminal Equipment (DTE)
and Data
Circuit-Terminating
Equipment (DCE) for
terminals operating in
the Packet-Mode and
accessing a Packet
Switched Public Data
Network through a Public
Switched Telephone
Network or a Circuit
Switched Public Data
Network

Recommendation X.96

Call Progress Signals in
Public Data Networks (PDN)

Recommendation X.121

International Numbering
Plan for Public Data
Networks

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

10.3. SELECTION CRITERIA

10.3.1 Parameters and selection.

10.3.1.1 Layer 1, the Physical Layer. This layer of the ISO model covers those standards that pertain to the interface of Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE).

10.3.1.1.1 FED-STD-1020 (RS-422). Electrical Characteristics of Balanced Voltage Digital Interface Circuits. FED-STD-1020 only covers electrical characteristics and was intended initially to be used with RS-449, a functional and physical connector standard. RS-422 should be used when both ends of the interface are covered by new procurements and balanced circuits are required. This standard is being implemented in a variety of new equipments, especially where data rates are above the performance capability of RS-423. (See Figure 2 for comparisons.) This standard will be the predominant standard for a wide variety of data communications hardware, such as high-speed modems, LAN interfaces, and other related interfaces operating in the 0-to-10-megabits-per-second range.

10.3.1.1.2 Implementation of RS-422. When RS-422 is to be used between a DTE and a modem (i.e., DCE), it is recommended that it be used in conjunction with the RS-449 standard. If this is not possible due to physical constraints, RS-422 may be implemented in non-standard vendor-supported implementations as required for speeds of 19.2 k bits per second and below. RS-449 should be implemented for speeds above 19.2 k bits per second, as well as future implementations of 16 kilobits per second, until the new intelligent mini-interface standard is available. RS-422 and RS-423 equipment will interface directly and provide the performance characteristics of RS-423.

10.3.1.1.3 FED-STD-1030 (RS-423). Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits. FED-STD-1030 covers only electrical characteristics and applies to all new procurements when unbalanced circuits are required. FED-STD-1030 is designed to be a path for RS-232 to RS-422 migration. EIA Bulletin 12 is to be consulted for a method of interfacing RS-232 and RS-423 equipment. It is intended for interfaces operating in the

baseband-to-100 kilobits per second range. (See Figure 2 for performance characteristics.) When interfaced with RS-232 equipment, the performance characteristics of RS-232 are to be expected. This standard is applicable when one end of the interface is covered by a new procurement, and the other (old) end is RS-232. Note that the RS-232 standard does not cover the physical connector.

10.3.1.1.4 Modems. FED-STD-1005 (2400 bits per second), FED-STD-1006 (4800 bits per second), FED-STD-1007 (9600 bits per second), and FED-STD-1008 (600 and 1200 bits per second). These standards set the signaling speed, encoding, carrier frequency and tolerance, impedance and similar characteristics required to obtain interoperability. These standards are applicable to all procurements for modems to be used on analog circuits, operating at and below 9600 bits per second. Federal standards do not cover modems for operation above 9600 bits per second. Secondary channels may be used for tech control applications.

10.3.1.1.5 Character structure, parity, and bit sequencing. FED-STD-1010/FIPS PUB 16-1, FED-STD-1011/FIPS PUB 17-1, FED-STD-1012/FIPS PUB 18-1, FED-STD-1013/FIPS PUB 22-1. These standards define the requirements for handling the exchange of ASCII/IA-5 information across a serial or parallel bit interface. These standards apply to all implementations.

10.3.1.1.6 High speed synchronous transfer. FED-STD-1001/FIPS PUB 37. This standard defines the synchronous high-speed signaling rates between DTE and DCE hardware, when transferring binary encoded information over a wideband communications channel. These channels have a greater bandwidth than the normal 4 kHz bandwidth found in analog voice transmission systems. Approved signaling speeds are selected in integral multiples of 8000 bits per second, commencing at 16,000 bits per second. The selected rates are presented in Table I.

10.3.1.1.7 Automatic calling. RS-366 is used between DTE and automatic calling equipment (i.e., DCE) for dial up circuits over the public switched network (analog) for circuits operating at 9600 bits per second and below.

10.3.1.1.8 FED-STD-1018/RS-496. This standard is used for connection to national, public switched networks (analog) between the DCE and the network.

10.3.1.1.9 Data encryption.

10.3.1.1.9.1 Use of the Data Encryption Standard (DES). FED-STD-1026, Interoperability and Security Requirements for Use of the Data Encryption Standard in the Physical Layer of Data Communications, prescribes the requirements for the use of the DES in Layer 1 implementations for on-line encryption applications. It is used in conjunction with FED-STD-1027. (See FIPS PUB 46 and FIPS PUB 81.)

10.3.1.1.9.2 Security requirements for the Data Encryption Standard. FED-STD-1027, General Security Requirements for Equipment Using the Data Encryption Standard, prescribes the security requirements for implementation of the Data Encryption Standard in government telecommunications equipment and systems. Application is determined by reference to NCSC-11, the National Policy for Protection of Telecommunications Systems Handling Unclassified National- Security-Related Information. System planners and managers should require the use of this standard in applications where security for the information covered by the Privacy Act, or other highly sensitive information is needed. The use of this standard is also appropriate for implementation of the DES in higher layers (Layer 5, 6, or 7) and in end-to-end or protocol related applications. When used in these higher layer applications it is important that proper planning and design activities be accomplished as part of the total system design, even if the use of DES will be added after initial operational status of the system.

10.3.1.2 Layer 2, the Link Layer. This layer establishes a functional data link over the combined physical assets of the interfaces and transmission media. Once the data link is established, messages or data can be transferred in a controlled manner. Character-oriented procedures should be replaced with bit-oriented procedures whenever possible. (High-level Data Link Control (HDLC) notation is used in the following paragraphs because it is the same notation used for aeronautical (i.e., ICAO) applications.)

10.3.1.2.1 Character-oriented procedures, 5-unit code. No U.S. standard applies, except that ICAO Annex 10 circuit procedures should be used on AFTN circuits unless other bilateral procedures are agreed to. Vendor procedures may be used in other non-AFTN applications. Alternately, ASCII/IA-5 procedures as defined in FIPS PUB 1-2 and ICAO Annex 10, Volume 1 should be implemented wherever it is possible to change the code set to IA-5.

10.3.1.2.2 Character-oriented procedures, 7-unit code. One of these three protocols should be used for all asynchronous timing implementations using ASCII/IA-5. They may be used for synchronous timing applications if one or more stations are not able to support bit-oriented procedures.

10.3.1.2.2.1 System Category A. This section covers the procedures for the transfer of ASCII/IA-5 information between computers or terminals operating in a two-way alternate multipoint configuration. The procedure allows for two types of control, centralized and decentralized. In centralized operation all message transfer takes place between the control station and one or more tributaries. In decentralized operation, tributaries are allowed to transfer information directly between themselves, as well as with the control station. The unit of transfer is a message. Maximum link efficiency is achieved with message lengths in the 800-to-1000-character range. It is not suitable for satellite circuits due to excessive transmission delay time.

10.3.1.2.2.2 System Category B. This section covers the procedures for the transfer of ASCII/IA-5 information between computers operating in a two-way simultaneous point-to-point configuration. Modulo 8 block numbering is provided to maintain maximum link efficiency over various transmission media. Efficient operation on a satellite circuit can be achieved at speeds up to 9600 bits per second. Message transfer is on a message-associated blocking basis, whereby a block can contain one, or part of one, message only.

10.3.1.2.2.3 System Category C. This section covers the procedures for the transfer of ASCII/IA-5 information between a computer and terminals operating in a two-way alternate multipoint configuration. Messages are transferred as complete units (Message - Oriented Transfer) using centralized operation. Maximum link efficiency is achieved with message sizes in the 800-to-1000 character size. It is not suitable for satellite circuits due to excessive transmission delay time. When link bit error performance is below 1:100,000 the message size must be reduced accordingly to achieve reasonable throughput. On switched circuits and non-switched circuits with high bit error probabilities the maximum message size should be reduced to the 200 to 300 character range.

10.3.1.2.2.4 Error detection and correction. Error detection is provided by the use of Block Check Character (BCC) procedures, as defined in ICAO Annex 10, Volume I, paragraph 4.12.4.4. The receiving station discards all data received with detected errors and requests retransmission by the use of Negative Acknowledgment (NAK) procedures. In Category B, when more than one unit of data can be outstanding, the receiving station will discard all higher numbered units of data received after the detected error as well. The returned NAK then has the meaning of check point recovery to the transmitting station, by directing it to roll back to the last known good point. No forward error detection/correction procedures are provided.

10.3.1.2.3 Bit-oriented synchronous procedures, HDLC and Advanced Data Communication Control Procedures (ADCCP). FED-STD-1003/FIPS PUB 71. This is the preferred protocol for FAA application, as well as for National Communication System (NCS) interoperability requirements. This standard provides for three modes (classes) of procedures that can be implemented in different configurations, as well as options that enhance recovery, testing and efficiency. These capabilities are important when designing networks, especially the extended modes when using satellite circuits. For this reason, designers are cautioned not to accept HDLC-like protocols and specific vendor implementations that do not implement the full repertoire of commands and responses. This standard is pertinent to applications where 8-bit code, bit/byte transparency, X.25 packet mode and satellite circuits operating at 9600 bits per second or higher are specified.

10.3.1.2.3.1 Data transfer. The unit of transfer is the frame, which contains user information in the I Field. The maximum recommended I Field size is 4096 bits (512 octets). The bit structure of the I Field is totally

independent of the link control processes. Therefore, message sizes are also independent, with any blocking, or reassembly functions taking place at a higher layer of the ISO OSI model. The transmission error detection capability is orders of magnitude better than what is normally found in character-oriented procedures.

10.3.1.2.3.2 Options. Currently, there are 12 options that can be implemented to enhance the basic set of commands and responses. These options should be selected on a configuration/implementation basis to achieve the best operational results. FIPS PUB 78 should be consulted for additional guidance.

10.3.1.2.3.3 Normal Response Mode (NRM). This is an unbalanced data flow configuration for multipoint applications. All data is exchanged between the Primary (i.e., computer) and one or more Secondaries (i.e., terminals) in a centralized manner. No Secondary-to-Secondary exchanges are permitted. Secondaries cannot transmit (respond) until they have received permission (polled). Multiple transmissions (more than one frame) can take place in either direction, up to a number one less than the modulus count (8 or 128).

10.3.1.2.3.4 Asynchronous Response Mode (ARM). This is an unbalanced (data flow) configuration for point-to-point or multipoint applications. It differs from NRM in that the Secondary may respond without being polled; i.e., asynchronously when there is a need to transmit. In multipoint configurations it is expected that all Secondaries, other than the one the Primary wishes to communicate with, are in the disconnected state. This mode is used when a large data transfer needs to take place with one Secondary, such as for a downline load of software. On point-to-point circuits it can be used for all data transfers to achieve higher link efficiency than would be possible using NRM. Reject (REJ) or Selective Reject (SREJ) can be used to achieve higher link efficiency during error recovery conditions.

10.3.1.2.3.5 Asynchronous Balanced Mode (ABM). This is a balanced (data flow) configuration for point-to-point applications, generally between two computers. Each end of the circuit is controlled by a Combined Station, which has all the attributes of a Primary and a Secondary. Therefore, all data flows asynchronously (without polling) in each direction at the same time. Multiple frame transmission and numbering are the same as in NRM or ARM. REJ or SREJ can be used to achieve higher link efficiency during error recovery conditions.

10.3.1.2.3.6 Non-operational modes. Three non-operational modes are specified for special situations occurring on the link. When a station is in one of these three modes it cannot support a data link for the transfer of user data. These modes are Normal Disconnected Mode, Asynchronous Disconnected Mode, and Initialization Mode (IM). The actual processes that occur as a result of receiving the IM command are not covered by the standard and may vary between implementors.

10.3.1.2.3.7 Error detection and correction. Error detection is provided by the use of Frame Check Sequence (FCS) procedures, as defined in ICAO Annex 10, Volume I, paragraph 4.12.3.2.2.1. These procedures are the same as those standardized by ISO 3309 and CCITT V.41. Frames received with detected errors are discarded and error recovery procedures are implemented to effect retransmission. Three possible methods of recovery can be used: check point (basic), Reject (continuous check point) or Selective Reject (retransmit only frame indicated). This selection allows the implementor to adapt the recovery mechanism to the link environment. No forward error detection/correction procedures are provided.

10.3.1.2.4 X-ON/X-OFF. This vendor protocol is strictly a flow control mechanism to be used to prevent buffer overflow, or loss of data, due to receiver not ready conditions for dumb asynchronous terminal applications. It can be used for locally connected devices as well as remote devices that are connected by physical or logical connections. The FAA implementation consists of two ASCII/IA-5 signals, DC1 (1/1) and DC3 (1/3), which are sent by the terminal to indicate status. The Terminal sends DC1 for an ON signal and DC3 for an OFF signal. No error correction by retransmission is possible using this protocol.

10.3.1.2.5 Local Area Network Link Level Protocols. The selection of a LAN Link Level protocol in many ways determines some of the physical characteristics of the network and it is not uncommon for a LAN product specification to include the Layer 1 and 2 specifications, as well as higher layers in some cases. In addition, the link protocol is also selected based on the traffic characteristics. New link protocols are being announced which are adaptive to the traffic characteristics, therefore allowing high efficiency under different environmental and configuration conditions. The two basic access control mechanisms are contention and token passing. Polling type protocols can also be used on LAN's; but the efficiency is 5-8% less than token passing generally. At this time the IEEE has approved a contention protocol similar to Ethernet known as IEEE Standard 802.3. FIPS PUB 107 specifies the use of 802.2 and 802.3 for Local Area Network use when a collision detection protocol is to be implemented. This standard applies to applications operating in the 1 to 10 Megabit per second range. IEEE Standard 802.4 is a token passing mechanism suitable for bus architectures, also operating in the 1 to 10 Megabit per second range for factory automation applications. IEEE Standard 802.5 is designed for token ring applications using coaxial cable and passive bypass relays. The Logical Link Control (LLC) protocol is specified by IEEE 802.2. This standard is based on the HDLC protocol, but has additional fields specified. The address fields may be 16 or 48 bits and they identify source and destination. Frame transfer is accomplished in a connection-less mode of operation. Addresses are identified as being local, group individual or universal. No federal standards currently exist for LAN protocols. IEEE fully compatible protocols are to be used in FAA local area networks except for small networks serving microcomputers and intelligent work station implementations. In the latter

case, protocols based on the ARCNet^(TM) protocol may be used where cost effective. If internetwork operation is required the gateway must provide the protocol conversion.

10.3.1.2.6 Local Area Network Selection. LAN systems procured for FAA applications should be selected based on the application requirements and if applicable have a gateway capability to access other LAN's, or users on external long haul networks. This gateway interfaces to external connections using the X.25 Packet Mode. The use of contention protocols should be avoided unless it is known that future traffic volume and network size can be accommodated. Broadband based LAN's should be avoided except where it is known that future growth and availability of the network cannot be accommodated economically with Baseband systems. Many broadband based LAN's require shutdown to accommodate changes or additions to the cable system.

10.3.1.3 Layer 3, the Network Layer. This layer establishes a functional path across a network for the exchange of data, called packets, between two users. The two basic types of transfer possible are connection or connection-less. A connection transfer is accomplished by establishment procedures that ensure that the two users are ready to communicate before user data is sent on the channel. Virtual Circuit (VC) and Permanent Virtual Circuit (PVC) procedures are implemented in this way. A connection-less transfer is used when the calling user is allowed to send, based on the assumption that the network and/or intermediate gateway(s), or called user have resources available to handle the data flow. Datagram procedures are one method of handling data in this way and is commonly used in LAN environments.

10.3.1.3.1 Comparison. Data transfer using public or private packet networks have a corresponding set of advantages and disadvantages that users need to be aware of for proper planning:

a. Advantages

1. Multiple logical (functional) circuits can exist across one physical interface connection. This reduces the number of I/O port requirements, intrafacility cabling and patching equipment costs.
2. Logical connectivity can be provided with all other users connected to the network. This reduces data communications costs because physical connectivity (leased circuit) is not required between all users.
3. Logical connectivity can be arranged on a permanent (PVC) basis or on demand (VC) basis.

4. Multiple network access and control mechanisms can be implemented for network and host resource security purposes.
5. Automatic reestablishment and rerouting of user information can be provided.
6. Centralized network management functions, including statistics and reports can be provided as an integral part of the network. (Private networks primarily).
7. Communicating users are not required to have the same type of interface.
8. Internetwork logical connections, such as LAN-PSN-LAN, LAN-PSN, or LAN-LAN, are possible with gateway and internetworking protocols.

b. Disadvantages

1. Network delays for logical transfers of data are somewhat longer than they would be with direct physical connections. With proper design and sizing, this is not a problem for most applications.
2. In public networks the transfer of large files is not usually cost effective.
3. In public networks the recovery, network security and data accountability may be less than desirable.

10.3.1.3.2 Packet Network Interface. The X.25 Packet Network Interface (CCITT) provides a multi-layer interface (the first three layers) that can be implemented using a set of user facilities. It is logically consistent with the 7-layer ISO model. The interface is subdivided into 11 user classes of service, with each class having a defined set of user facilities. Layer 3 is where the user information is placed into packets for transfer over the network. This interface is usually implemented with the user being in Packet Mode, whereby all three layers are implemented in the user equipment. Layer 2 is provided by High-level Data Link Control/Asynchronous Balanced Mode, called Link Access Procedure-Balanced by CCITT. Layer 1 is provided by RS-232, RS-449, or Recommendation X.21 (sync). This implementation also requires that companion CCITT standards be implemented to fully complete the interface characteristics. These are: Recommendation X.1, User Classes of Service; Recommendation X.2, User Services and Facilities; and Recommendation X.121, International User Addressing. It is also permissible in certain cases to implement interfaces where the user is unable to operate in Packet Mode internally. For these applications, the interfacing node in the network

implements a Packet Assembly/Disassembly (PAD) facility and the two lower layers can also be different. Recommendation X.3, Recommendation X.28 and Recommendation X.29 apply to PAD facilities. FIPS PUB 100/FED-STD-1041 applies to U.S. implementations of Packet Mode operations with public networks. Call Progress Signaling is covered by Recommendation X.96. Recommendation X.32 provides for switched circuit access between a packet switched network and a DTE operating in the Packet Mode. FAA application should be in accordance with FIPS PUB 100, as well as the new features found in the 1984 version of the Recommendation X.25 standard.

10.3.1.4 Layer 4, the Transport Layer. Transport layer protocols have, up to this point in time, been developed for specific types of networks (private and public). The actual protocols exist across a network (between two users) in most cases. Recent efforts by ISO and ANSI have resulted in ISO 8073 Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification. This standard is designed for connection-oriented procedures, whereby the logical path is established before any user data is transferred. It assumes that network services, such as provided by Recommendation X.25, are available. A draft proposal for adding connection-less mode procedures to the protocol is being coordinated within ISO.

10.3.1.4.1 Transport Service. The ISO Transport specification supports the transport service defined in ISO/DIS 8072, a draft standard document. These transport layer functions are those necessary to bridge the gap between the service available from the Network Layer, and those offered to the Transport Service Users (Layers 5 and higher).

10.3.1.4.2 Transport Protocol. ISO 8073 provides 5 classes of transport service, all of which may not be applicable to the FAA. The transport service is provided by connection establishment, data transfer and release procedures. The connection procedure provides for navigation between transport peers for the class of services, as well as other operationally related features. These features effect concatenation and separation, segmenting and reassembly, multiplexing and demultiplexing, splitting and recombining, and flow control.

10.3.1.5 Layer 5, the Session Layer. This layer opens and closes requests for Transport Service (Session-oriented) to Layer 4. Therefore, there must be common interface standards between the Host and the Front-End Processor (FEP) to effectively communicate. ISO/DIS 8326 defines the basic connection-oriented session services required for information transfer. The supporting protocol is defined in ISO/DIS 8327.

10.3.1.6 Layer 6, the Presentation Layer. This layer establishes the method of communications between the external users, thus code sets and control mechanisms are contained in this layer. This layer converts the required

external 7-unit code, or its extension sets, into the native code of the computer, if it is different. It is expected that additional application-oriented standards will be added to this section as they become available.

10.3.1.6.1 Character code sets.

10.3.1.6.1.1 5-Unit code set international AFTN applications. ITA-2 defines the 5-unit code set for mandatory use in international AFTN applications where IA-5 cannot be implemented. The full code set is not available for use due to certain restrictions imposed by CCITT and ICAO.

10.3.1.6.1.2 ASCII 7-unit code set. FIPS PUB 1-2 implements the ASCII 7-unit code set for use in national applications between systems and equipment, including removable storage media. A compatible code set, IA-5, as standardized by ICAO, ISO, and CCITT, is required for international applications. The FAA must therefore maintain strict conformance to these standards to ensure interoperability with aviation system users and maintain minimum system costs. These standards do not apply to bit stream, graphical and other similar applications.

10.3.1.6.2 Code set extensions, graphic assignments, and subsets

10.3.1.6.2.1 Subsets of the ASCII standard. FIPS PUB 1-2 defines the three specific subsets of the full 128 character ASCII standard. These subsets are for receiving devices that do not need to display the full code set. The three approved subsets are 95, 64, and 16 characters. FIPS PUB 1-2 also adopts ANSI X3.32-1973 and X3.41-1974.

10.3.1.6.2.2 Code extension techniques. ANSI X3.41-1974 defines the approved code extension techniques for applications using 7 or 8 bits. These extensions are used to evoke multiple code and graphic sets for use with the basic 7-unit code set. This standard should be used when the basic 7-bit code is not sufficient to convey the required information.

10.3.1.6.2.3 Approved codes and pictorial symbols. ANSI X3.32-1973 defines the approved 2-letter codes and pictorial symbols for the 32 control characters in columns 0 and 1, as well as Space and Delete.

10.3.1.6.2.4 Encoded control functions. FIPS PUB 86 defines a set of encoded control functions that can be used in several types of applications including remote cursor movement, display attributes, and remote formatting. This type of information generally precedes the exchange of user information. This standard should be used when the basic control features of FIPS PUB 1-2 are not sufficient to invoke remote control events.

10.3.1.7 Layer 7, the Application Layer. Emerging standards for general applications (Inquiry, File Transfer, et. al.) will be added to this standard at a later date.

10.3.1.8 General application and documentation standards. This paragraph contains additional information on required standards that are not appropriately placed in the 7-layer model.

10.3.1.8.1 Perforated tape code for information interchange. FIPS PUB 2-1 should be used to specify the representation of ASCII on perforated tape systems used by the government.

10.3.1.8.2 Recorded magnetic tape for information interchange (800 CPI, Non-Return to Zero Inverted (NRZI)). FIPS PUB 3-1 should be used to specify the characteristics, including format, of 9-track, one-half-inch-wide magnetic computer tape for information storage. The recording density of the ASCII is 800 characters per inch.

10.3.1.8.3 Recorded magnetic tape for information interchange (1600 CPI, phase encoded). FIPS PUB 25 should be used to specify the characteristics, including format, of 9-track digital one-half-inch-wide magnetic computer tape. The recording density of the ASCII is 1600 characters per inch.

10.3.1.8.4 Recorded magnetic tape for information interchange, (6250 CPI, 246 characters per millimeter, group coded recording). FIPS PUB 50 should be used to specify the characteristics, including format, for 9-track, one-half-inch-wide magnetic computer tape. The recording density is 6250 characters per inch (246 characters per millimeter).

10.3.1.8.5 Transmittal Form for Describing Computer Magnetic Tape File Properties. FIPS PUB 52 requires the use of form SF-277 for tape transmittal purposes and includes instructions for completing the form. The completed form documents the physical properties and characteristics of the recorded tape file.

10.3.1.8.6 Representations of local time of the day for information interchange. FIPS PUB 58 should be used to define the format and structure for keeping local time in both 12 and 24-hour systems. It is intended for use in administrative, or other types of systems that do not adhere to military 24-hour date time group, or the ICAO 24-hour date time group.

10.3.1.8.7 Magnetic tape labels and file structure for information interchange. FIPS PUB 79 should be used to define magnetic tape labels and file structure for information interchange, via magnetic tape. It applies to 9-track tape drives.

10.3.1.8.8 Group 2 facsimile apparatus for document transmission. FED-STD-1061 should be used to define the machine specifications for Group 2 facsimile equipment to be used on voiceband analog circuits.

10.3.1.8.9 Group 3 facsimile apparatus for document transmission. FED-STD-1062 should be used to define the machine specifications for Group 3 facsimile equipment to be used on voiceband analog circuits.

10.3.1.8.10 Procedures for document facsimile transmission in the general switched telephone network. FED-STD-1063 should be used to establish a set of uniform procedures for facsimile transmission in the General Switched Telephone Network.

10.3.1.8.11 Computer based message systems. FIPS PUB 98, Message Format for Computer-Based Message Systems (CBMS) should be used for message communications across a network between two or more CBMS's. It identifies the peer-to-peer relationships between host computers for electronic mail applications.

10.3.1.9 Gateways. Gateways are generally provided between two types of networks, such as the National Airspace Data Interchange Network (i.e., NADIN) and a Local Area Network (LAN), or between FAA's operational (i.e., NADIN) and administrative (i.e., ADTN) data communication networks. Some type of protocol conversion and buffering is required to allow for data transfer between the two environments, which will be implemented on one side of the interface. When interfacing to non-FAA users it is necessary to refer to current policy (Order 1830.1) on who will provide the conversion. As a general rule the non-FAA network is required to provide the conversion. The ISO/DIS 8473 Internetwork Protocol should be used for logical connections between high-level networks.

10.3.2 Inventory of essential characteristics. This section details the characteristics which delineate the differences between communications standards for different levels of the ISO model.

10.3.2.1 Layer 1, the Physical Layer.

CHARACTERISTIC	RS-232*	RS-449**	RS-422	RS-423
MAX SIGNALING SPEED/DISTANCE	20kb/s 50 ft.		10Mb/S 40 ft.	100kb/S 40 ft.
MAXIMUM DISTANCE	50 ft.		4000 ft.	4000 ft.
AVAILABLE PINS	25	37/9		
SECONDARY CHANNEL	YES	YES		
SIGNAL QUALITY	YES	YES		
RING INDICATOR	YES	YES		
LOAD IMPEDANCE	3-7K OHMS		100 OHMS	450 OHMS
BINARY ONE	-3 TO -25 VDC		-2 TO -6 VDC	-4 TO -6 VDC
BINARY ZERO	+3 TO +25 VDC		+2 TO +6 VDC	+4 TO +6 VDC
ELECTRICAL CHARACTERISTICS				
-RECEIVERS CAT 1	UNBAL		BAL	BAL
-RECEIVERS CAT 2	UNBAL		UNBAL	UNBAL
-GENERATORS CAT 1	UNBAL		BAL	UNBAL
-GENERATORS CAT 2	UNBAL		UNBAL	UNBAL

* The 25-pin connector used in RS-232 applications is not part of the standard.

** The RS-449 connector is part of the standard and consists of a 37-pin connector for the primary communication channel, and a 9-pin connector for the low speed secondary channel. This arrangement eliminates the need for "Y" cables when connecting DTE's with DCE's.

UNBAL: An unbalanced interface uses a single signal line and a ground return.

BAL: A balanced interface uses two signal wires in a twisted pair configuration with a shield for each pair.

10.3.2.2 Layer 2, the Link Layer.

10.3.2.2.1 Character-Oriented Procedures. Character-Oriented Procedures, 7-unit code are portrayed below, for asynchronous and medium speed synchronous applications, using switched or non-switched circuits.

CHARACTERISTIC	CAT A	CAT B	CAT C
SWITCHED CIRCUITS	YES	YES	YES
ASYNCHRONOUS	YES	YES	YES
SYNCHRONOUS	YES	YES	YES
PARITY	YES	YES	YES
BCC	YES	YES	YES
TWO-WAY ALTERNATE	YES	NO	YES
TWO-WAY SIMULTANEOUS	NO	YES	NO
MESSAGE FRAMING	MO	MA	MO
# OUTSTANDING	ONE	SEVEN	ONE
DELIVERY VERIFICATION	YES	NO	NO
REPLIES	NO	YES	YES
FAST SELECT	NO	NO	YES
CENTRALIZED CONTROL	YES		YES
DECENTRALIZED CONTROL	YES		NO
SATELLITE CIRCUITS	NO	YES	NO
TRANSPARENT TEXT	NO	NO	NO

MO = Message Oriented. Each user message is transferred across the data link as a complete unit, i.e. no segmenting of the message.

MA = Message Associated. Each user message longer than the maximum block size is segmented into two or more blocks. The last block of each message is a variable size between 1 and the maximum number of characters for a block. Only one, or part of one, message can be in the block.

10.3.2.2.2 Bit-Oriented Procedures. Bit-Oriented Procedures are portrayed below for HDLC, for synchronous, medium and high speed applications, using switched and non-switched circuits.

CHARACTERISTIC	CMD	RES	NRM	ARM	ABM	REMARKS
SWITCHED CIRCUITS			YES	YES	YES	(X1D)
TWO-WAY ALTERNATE			YES	NO	NO	
TWO-WAY SIMULTANEOUS			NO	YES	YES	
ERROR DETECTION			YES	YES	YES	FCS (Note 1)
EXTENDED MODES			YES	YES	YES	
SATELLITE CIRCUITS			YES	YES	YES	WITH # EXTN
MULTIPOINT			YES	YES	NO	
POINT TO POINT			YES	YES	YES	
#OUTSTANDING FRAMES			7	7	7	BASIC
#OUTSTANDING FRAMES			127	127	127	EXTENDED
APPLICABLE OPTIONS						
1A ADD	X1D	X1D	YES	YES	YES	SW CKTS
1B ADD		RD	YES	YES	YES	
2 ADD	REJ	REJ	NR	YES	YES	NOT RECMD.
3 ADD	SREJ	SREJ	NR	YES	YES	NOT RECMD.
4 ADD	UI	UI	YES	YES	YES	
5 ADD	SIM	RIM	YES	YES	YES	
6 ADD	UP		YES	YES	YES	
7 ADD EXTND ADDR			YES	YES	YES	
8 DELETE		I	YES	YES	YES	
9 DELETE	I		YES	YES	YES	
10 ADD	SNRME		YES	NO	NO	
10 ADD	SARME		NO	YES	NO	
10 ADD	SABME		NO	NO	YES	
11 ADD (NOTE 2)	RSET		NO	NO	YES	
12 (NOT APPROVED BY ISO)						
13 ADD	TEST	TEST	YES	YES	YES	

Note: 1. CRC-16 IS NORMALLY IMPLEMENTED. CRC-32 IS AVAILABLE UNDER FED-STD-1003 AND IS BEING ADDED TO THE ADCCP AND ISO STANDARDS.

2. THIS OPTION IS A DELETE IN ADCCP.

10.3.2.2.3 LAN Protocols. TBD.

10.3.2.3 Layer 3, the Network Layer.

a. User Classes of Service for Packet mode or PAD mode.

<u>Class</u>	<u>Mode</u>	<u>Speed</u>	<u>Units/Character</u>	<u>Code</u>
1	S/S	300	11	IA-5
2	S/S	50*	7.5	ITA-2
	S/S	100*	7.5	ITA-2
	S/S	110	11	IA-5
	S/S	134.5*	9	
	S/S	200	11	IA-5
3	BSC	600*	10	IA-5
4	BSC	2.4K	8	IA-5
5	BSC	4.8K	8	IA-5
6	BSC	9.6K	8	IA-5
7	BSC	48K**	8	IA-5
8	PM	2.4K	8	IA-5/BYTE
9	PM	4.8K	8	IA-5/BYTE
10	PM	9.6K	8	IA-5/BYTE
11	PM	48K**	8	IA-5/BYTE

* Not recommended for FAA use.

** See FED-STD-1041/FIPS PUB 100

b. X.25 Packet Interface as Implemented by FED-STD-1041/FIPS
PUB 100.

User Facility	<u>VC</u>	<u>PVC</u>
Optional user facilities assigned for an agreed contractual period:		
Extended packet sequence numbering (modulo)	A	A
Non-standard default window sizes	A	A
Non-standard default packet sizes 16, 32, 64, 256, 512, 1024	A	A
Default throughput class assignment	A	A
Flow control parameter negotiation	E	-
Throughput class negotiation	E	-
Packet retransmission	A***	A***
Incoming calls barred	E	-
Outgoing calls barred	E	-
One-way logical channel outgoing	E	-
One-way logical channel incoming	A	-
Closed user group	E	-
Closed user group with outgoing access	A	-
Closed user group with incoming access	A	-
Incoming calls barred within a closed user group	A	-
Outgoing calls barred within a closed user group	A	-
Bilateral closed user group	A	-
Bilateral closed user group with outgoing access	A	-
Reverse charging acceptance	A	-
Fast select acceptance	A**	-
D-bit modification	A	A
Optional user facilities requested by the DTE on a per call basis		
Closed user group selection	E	-
Bilateral closed user group selection	A	-
Reverse charging	A	-
RPOA selection	A	-
Flow control parameter negotiation	E	-

Fast select	A**	-
Throughput class negotiation	E	-
Abbreviated address calling	FS	-

NOTE: Detailed explanations of these facilities are provided in CCITT Recommendation X.25.

LEGEND:

E = An essential user facility to be offered by all networks.
A = An additional user facility which may be offered by certain networks.
FS = Further study is required.
- = Not applicable.
VC = Applicable when the virtual call service is being used.
PVC = Applicable when the permanent virtual circuit is being used.

** - Fast select is provided by all DCE's. All DTE's associated functionality which allows response to a fast select packet must be capable of select packets, but need not generate fast select packets.

*** - The packet retransmission facilities should not be used.

10.3.2.3.1 X.25 Datagram Service. The transfer of datagram packets across Packet-Switched Networks (PSNs) will not be supported by the 1984 version of Recommendation X.25. Optional fast select facilities may be used for this type of transfer.

10.3.2.3.2 X.25 Verification Testing. A standard reference manual for verification testing of X.25 Interfaces has been developed and published by the National Bureau of Standards, Institute for Computer Sciences and Technology (ICST). A copy of the verification software can be obtained by writing ICST, Center for Computer Systems Engineering. The software is available on floppy disk, in machine language, for implementation on a DYNPAC NET/18 protocol tester with dual auxiliary floppy drive. To complete the configuration the system disk NET/18 HS LEARN/DEBUG version 2.18 or higher, and Utility disk version 1.6 is required. The Defense Communication Engineering Center for the Defense Communications Agency (DCA) has also verified these procedures for equipment conformance to the Defense Digital Network (DDN). DCA's protocol tester is the Chameleon from Tekelec, Inc.. The use of this verification test should be called out in FAA procurements.

10.3.2.4 Layer 4, the Transport Layer. Standards applicable to this layer are currently under development and are not available for inclusion in this standard. Later revisions of this standard will include new standards applicable to this layer as they become available.

10.3.2.5 Layer 5, the Session Layer. Standards applicable to this layer are currently under development and are not available for inclusion in this standard. Later revisions of this standard will include new standards applicable to this layer as they become available.

10.3.2.6 Layer 6, the Presentation Layer. Presentation Layer standards are determined by the Application Layer and subsequently are not defined by this appendix.

10.3.2.7 Layer 7, the Application Layer. The contents of Layer 7, the Application Layer, are totally user determined and are not addressed by this standard.

10.4 QUALITY ASSURANCE PROVISIONS

This section is not applicable to this Appendix.

10.5 PREPARATION FOR DELIVERY

This section is not applicable to this Appendix.

10.6 NOTES

10.6.1 Definitions.

10.6.2 Acronyms and abbreviations. Acronyms and abbreviations used in this Appendix have been defined in Section 6 of this standard.

FAA-STD-029
February 26, 1986

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APPENDIX II

20. VOICE STANDARDS SELECTION

20.1 SCOPE

20.1.1 Scope. This appendix contains, in summary form, a description of the features and parameters of the Voice Standards. Selection criteria is included where appropriate.

20.1.2 Purpose. This Appendix presents analog and digital transmission standards and is arranged by area of applicability including telephone equipment compatibility, data communication, transmission, engineering, private line facilities, digital transmission systems, testing, and private line channel network compatibility.

20.2 APPLICABLE DOCUMENTS

20.2.1 Non-Government documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal, form a part of this appendix to the extent specified herein.

STANDARDS:

American Telephone and Telegraph (AT&T)

PUB 43801

Digital Channel Bank -
Requirements and
Objectives

PUB 61201

Compatibility
Information for Feature
Group D Switched Access
Service

Electronic Industries Association (EIA)

RS-464

Private Branch Exchange
(PBX) Switching
Equipment for Voice Bank
Applications

RS-470

Telephone Instruments,
with Loop Signaling, for
Voiceband Applications

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

20.3. SELECTION CRITERIA

20.3.1. Parameters and selection. This subsection contains the basic information necessary to describe in summary form the features and parameters of the standard relating to voice circuits, as well as their applicability.

20.3.1.1 Telecommunications standards - telephone equipment compatibility. These documents define the characteristics necessary to assure compatibility between AT&T or Other Common Carrier (OCC) equipment and Customer Provided Equipment (CPE). Because of the breakup of the Bell Telephone System, these documents have become de facto industry standards for telephone systems, since most existing equipment remains the property of AT&T and is connected to other common carriers only in accordance to the specifications in these documents. These documents are pertinent if an equipment item/subsystem interfaces with the Public Switched Telephone Network (PSTN) or other leased lines. A description of each is listed with comments on applicability to FAA-specific networks and equipment.

20.3.1.1.1 Interface Between DCE and PSTN. FED-STD-1018 (RS-496) should be used to describe the interface between Data Circuit-Terminating Equipment (DCE) and the PSTN.

20.3.1.1.2 Signaling characteristics among PBXs. RS-464 is applicable to PBX switching equipment in voiceband applications.

20.3.1.1.3 Loop signaling. RS-470 should be used to define loop signaling for voiceband applications.

20.3.1.2 Data communications. These documents indicate the characteristics and interface requirements for the use of voice grade circuits for data transmission.

20.3.1.2.1 High speed data over wideband communications channels. FED-STD-1001 is used to establish signaling rate requirements for data terminal and data processing equipment which are (1) employed with synchronous data communication equipment and (2) designed to operate on binary encoded information over wideband communications channels having greater bandwidth than the normal 4kHz bandwidth commonly used in analog voice transmission.

20.3.1.2.2. Interface circuit characteristics. FED-STD-1020 (RS-422) specifies the electrical characteristics of balanced voltage digital interface circuits that are to be employed for the interchange of serial binary data, timing, and control signals between voice or data telecommunication equipment where information is being conveyed at the DC baseband level at data signaling rates up to 10 Megabits per second. FED-STD-1030 (RS-423) specifies the electrical characteristics of unbalanced voltage digital interface circuits that are to be employed for the interchange of serial binary data, timing, and control signals between voice or data telecommunication equipment where information is being conveyed at the DC baseband level at data signaling rates up to 100 kilobits per second. Both standards apply to equipment employing balanced or unbalanced interface circuits.

20.3.1.2.3 Analog parameters for data transmission. PUB-41008 is a tutorial describing analog parameters which may affect data transmission over voiceband channels. This publication is used as a basis for engineering evaluations to establish data transmission technical requirements for customer provided data transmission equipment.

20.3.1.2.4 Measurement of data transmission characteristics. IEEE Standard 783-1984 outlines general techniques used in measuring transmission characteristics of telephone channels. This engineering analysis procedure is be used to determine viable customer-provided data transmission test sets.

20.3.1.3 Transmission engineering. These technical references provide the criteria for terminating and testing customer provided equipment which interfaces to the transmission media (e.g., leased lines).

20.3.1.3.1 Criteria for voice frequency transmission and signaling equipment. PUB 43002 gives the minimal criteria necessary to determine whether voice frequency transmission and signaling equipment for metallic facilities is suitable for use on customer premises. It is a compilation of requirements and objectives together with compliance test procedures for determining if specific products meet the stated criteria. This is applicable to any piece of voice transmission or signaling equipment that is intended to interface with leased facilities.

20.3.1.3.2 Maintenance terminating units. PUB 43003 provides requirements and objectives for a 2-wire maintenance terminating unit for voice frequency special services. A maintenance terminating unit is a device that is placed on the network side of the demarcation point at a customer location as an aid in determining proper performance of the channel without dispatching a craftsperson to the customer location. PUB-43004 provides requirements and objectives for a 4-wire maintenance terminating unit for voice frequency special services. These publications are applicable to automated maintenance procedures and built-in test equipment on customer provided hardware that interfaces leased voice frequency transmission facilities.

20.3.1.3.3 Interface with 2-wire PBX trunk. PUB 43005 provides the parameters of an impedance compensator with gain to meet terminal balance requirements at the customer end of a 2-wire PBX trunk. This is applicable to customer provided PBXs that interface leased facilities or the Public Switched Telephone Network.

20.3.1.4 Private line facilities. Technical references in the following three paragraphs describe interfaces to private line facilities by customer provided systems and equipment.

20.3.1.4.1 Equipment interface to voice grade communications channels. PUB-43101 describes the various entrance facility serving arrangements, provides transmission characteristics of entrance facilities, describes signal power limitations and discusses the division of responsibility for design, operation and maintenance. This is applicable to any customer provided equipment intended to interface with voice grade communications channels. PUB 43201 describes the standard private line offerings for voice applications which may be interconnected at one or both ends with customer-provided voice communications systems or terminal equipment. They describe minimum protection criteria, signaling arrangements and maintenance techniques. These are applicable to any customer provided communications equipment intended to interface leased private lines.

20.3.1.4.2 Mobile terminals/phones. PUB 43301 provides interface specifications that are intended as a guide to users of Customer Provided Mobile Terminals to assure compatibility with Bell System Domestic Public Land Mobile Radio Service. This applies to a dial-up link to mobile phones from a PBX (such as in maintenance operations).

20.3.1.4.3 Private line metallic circuits. PUB 43401 describes the signal level criteria objective for private line metallic circuits (cable pairs without signal battery or amplification devices). This material is provided for those who use the metallic continuity or local private line channels implemented by wire pairs. It should be noted that the Telephone Companies have no obligation to provide line channels on a metallic basis. This applies to leased services from AT&T and other operating companies.

20.3.1.4.4 Private line devices. PUB 43701 supplies information concerning the technical parameters of private line services. The document describes the voiceband services which can be provided, associates each service with all applicable terminations, and describes the functional operation of the service. In addition, PUB 43701 lists the interfaces with which the services can be terminated for connection to a customer or OCC provided communications channel and describes, in detail, the characteristics of each interface. PUB 43701 should be used when an interface to the communications channels exists. A summary of the operational features of telephone company-provided switching equipment located at the remote ends of the customer's composite communications configuration will be supplied (to the customer) to allow the customer to ensure the compatibility of the remote terminations. PUB 43720 describes the technical content and use of the compatibility checklists. These forms are provided by the operating telephone company to the customer and describe certain characteristics of the Bell switch termination. These characteristics include the type of outpulsing control that can be provided (delay dial, wink start, dial tone), the type of addressing that can be generated outgoing and accepted incoming (TOUCH-TONE or Dial Pulse), and the maximum number of digits that can be outpulsed. PUB 43720 is used in conjunction with PUB 43701.

20.3.1.5 Digital transmission systems. Technical references in the following three paragraphs describe the requirements for an interface to digital systems as provided by Bell or other-common carriers.

20.3.1.5.1 Facility maintenance features. PUB 43803 describes facility maintenance features required for interoffice digital transmission systems. This document gives manufacturers of interoffice digital equipment the detailed requirements needed to incorporate maintenance features into the equipment that they manufacture. These requirements are consistent with the Bell Plan for centralized and automated maintenance of the highly complex

rapidly growing digital network. This publication is used as an engineering assessment of communications network automated maintenance requirements for digital transmission systems.

20.3.1.5.2 Network terminal equipment. PUB 43804 provide suppliers of the Network Terminal Equipment (NTE) and operations systems with the information necessary to follow the regional companies standards on the NTE operations interfaces and with guidelines needed to interface NTEs with the regional companies operations system. Operations planners are provided with technical details and future directions for the integration of the NTE operations support with its operations systems and operations centers. The implementation of centralization and mechanization of NTE operations support as expounded in the Integrated Special Services Network (ISSN) is also covered for planners. This is applicable to areas such as network control and tandem switch configuration control.

20.3.1.5.3 Lightwave digital transmission. PUB 43806 provides requirements and objectives for lightwave digital transmission systems intended for use between central offices within metropolitan areas. It covers systems using multimode technology, including wavelength division multiplexing but not single-mode technology. This is applicable to customer provided electro-optical conversion and transmission equipment intended for interface with leased optical transmission lines.

20.3.1.6 General type testing. PUB 61310 describes the network access interface specifications to a circuit switched digital capability. This capability will provide for the digital transmission of data at 56 kilobits per second and alternately, the transmission of analog voice signals. This publication provides the Network Access Interface Specifications to this capability in the following sections: network interface electrical and physical characteristics, data transmission plan, signaling plan, network synchronization, network interface protocol and network maintenance. This is applicable to multiplexed analog voice, encrypted analog voice and high speed digital equipment interface requirements for customer provided equipment intended to interface leased wideband circuits.

20.3.1.7 Private line channel network compatibility and performance specifications. These technical references describe the network to customer provided equipment interface and are applicable as indicated.

20.3.1.7.1 HPDC - type D5 conditioning on voice grade data channels. PUB 62103 provides design rules and requirements for HPDC-Type D5 Conditioning on Multi-Point Private Line (3002-Type) voice grade data channels. This is applicable to high speed multiplex channels and customer provided equipment interface channels.

20.3.1.7.2 Interface to private line off-premises station lines. PUB 62113 describes the interface to private line off-premises station lines that accommodate registered terminal equipment having facility interface codes OL13A, OL13B and OL13C. This applies to customer provided remote telephone stations that will interface customer owned PBXs over leased lines.

20.3.1.7.3 Network channel interface for tie trunks that accommodate registered terminal equipment. PUB 62114 describes the interface to private line tie trunks that accommodate four wire lossless, Type I and Type II E and M Connections (M-Lead originates). PUB 62115 describes the interface to private line tie trunks that accommodate four wire lossless, Type I and Type II E and M Connections (E-Lead originates). This is the standard for the interfacing of customer provided equipment to PBX tie trunks.

20.3.1.7.4 Group and supergroup service offerings. PUB 62200 provides customer interface and transmission specifications for group (60-108 kHz) and supergroup (312-552 kHz) service offerings. This is applicable to multiplex interfaces and equipment transmission requirements for customer provided equipment intended for interface to Bell System private line channel network.

20.3.1.7.5 Digital data system interface. PUB 62310 describes the Digital Data System (DDS) interface to the customer's data terminal equipment. Performance objectives, testing and maintenance considerations, DDS loop makeup and requirements, signal characteristics and customer provided equipment requirements are covered. It is used to describe signal characteristics and interface requirements for customer provided equipment intended for use on DDS.

20.3.1.7.6 Network interface. PUB 62411 defines the electrical and physical parameters at the Network Interface (NI) to comply with FCC Docket 81-216 which permits compatible operation of customer provided digital terminating equipment with High Capacity Digital Service (HCDS). The reference is applicable to customer provided high speed data equipment intended with the high capacity digital services.

20.3.1.7.7 Switched access services. PUB 62500 describes Switched Access Services (SAS) provided to The Interlocal Access and Transport Area Carrier by the telephone company. SAS offerings are described by providing transmission and interface technical details for each feature group. It is used to detail available features provided by the telephone company on the switched access services system.

20.3.1.7.8 Dedicated access line special services. PUB 62501 describes the 13 voice grade and dedicated access lines special services in technical detail to allow each service to be incorporated into an end-to-end Interlocal Access

and Transport Area Carrier offering. Service offerings have been condensed into fewer offerings defined by technical differences rather than use of differences. It is used to describe available services provided on dedicated access lines by common carrier.

20.3.1.7.9 Narrowband special access services. PUB 62502 covers the Narrowband Special Access Services distinguishing service features, technical specifications and valid interfaces offered by the telephone companies to the Interlocal Access and Transport Area Carrier. It is pertinent to the determination of the compatibility of services available to customer voice and data transmission systems.

20.3.1.7.10 Program audio special access services. PUB 62503 describes the Program Audio Special Access Services' distinguishing service features, technical specifications and valid interfaces offered by the telephone companies to the Interlocal Access and Transport Area Carrier. It is used to determine the compatibility of services available to customer voice and data transmission systems.

20.3.1.7.11 Television special access services. PUB 62504 describes the Television Special Access Services' distinguishing service features, technical specifications and valid interfaces offered by the telephone companies to the Interlocal Access and Transport Area Carrier. It is used to determine the compatibility of services available to customer voice and data transmission systems.

20.3.1.7.12 Wideband special access services. PUB 62505 details the Wideband Analog Special Access Services' distinguishing service features, technical specifications and valid interfaces offered by the Telephone Companies to the Interlocal Access and Transport Area Carrier. PUB 62506 describes the Wideband Digital Special Access Services' distinguishing service features, technical specifications and valid interfaces offered by the telephone companies to the Interlocal Access and Transport Area Carrier. They are used to determine the compatibility of services available to customer voice and data transmission systems.

20.3.1.7.13 Digital access services. PUB 62507 covers the Digital Data Special Access Services' Distinguishing service features, technical specifications and valid interfaces offered by the telephone companies to the Interlocal Access and Transport Area Carrier. PUB 62508 covers High Capacity Digital Access Services' distinguishing service features, technical specifications and valid interfaces offered by the telephone companies to the Interlocal Access and Transport Area Carrier. These documents are used to determine the compatibility of services available to customer voice and data transmission systems.

20.4 QUALITY ASSURANCE PROVISIONS

This section is not applicable to this Appendix.

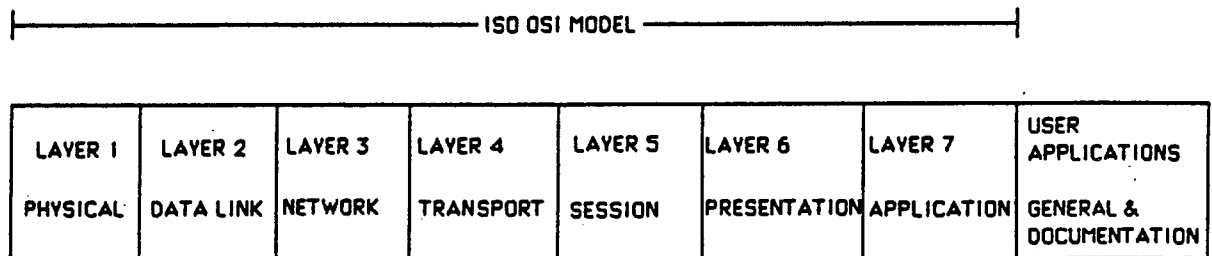
20.5 PREPARATION FOR DELIVERY

This section is not applicable to this Appendix.

20.6 NOTES

20.6.1 Definitions.

20.6.2 Acronyms and abbreviations. Acronyms and abbreviations used in this appendix have been defined in Section 6 of this Standard.



10.3.2 Parameters and Selection

10.3.2.1 10.3.2.2 10.3.2.3 10.3.2.4 10.3.2.5 10.3.2.6 10.3.2.7 10.3.2.8

10.3.3 Inventory of Essential Characteristics

10.3.3.1 10.3.3.2 10.3.3.3 10.3.3.4 10.3.3.5 10.3.3.6

Figure 1. Diagrammatic Tree

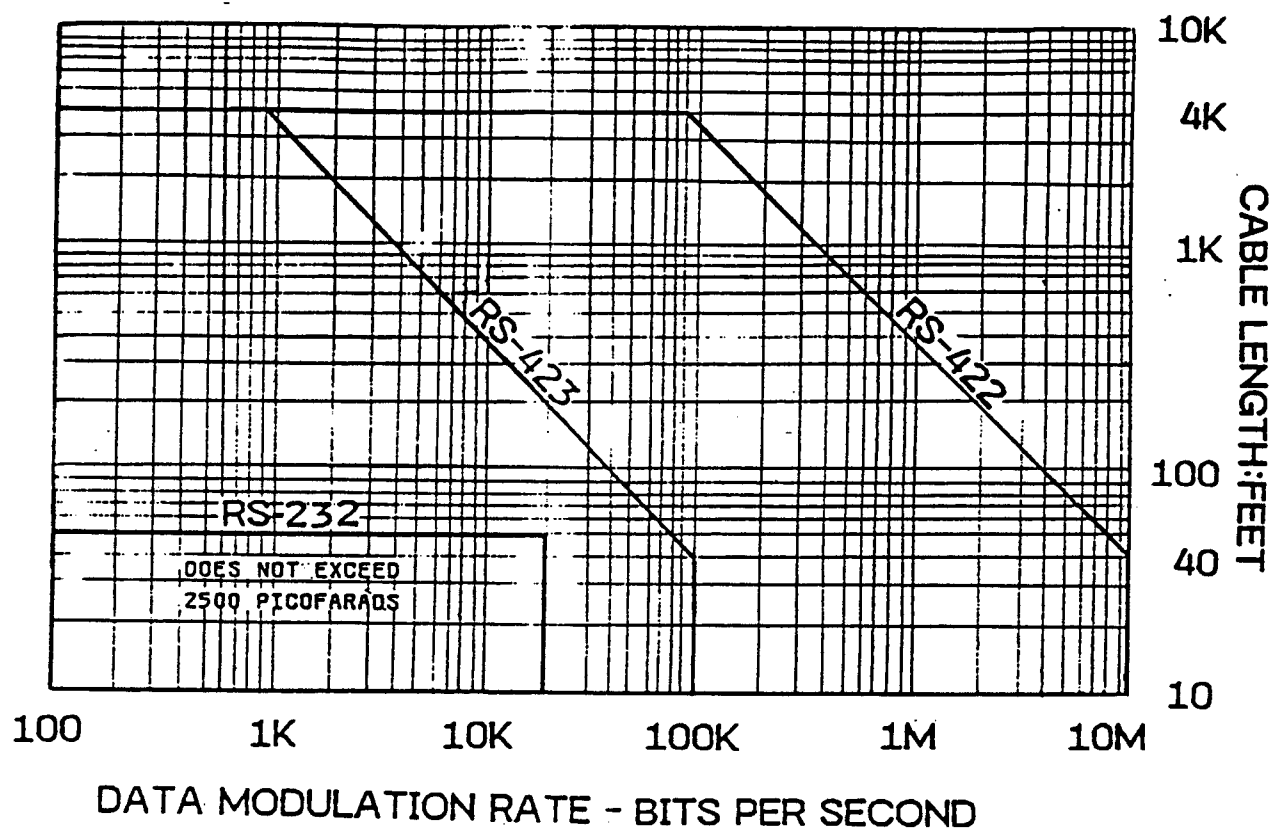


Figure 2. Data Modulation Rate Versus Cable Length
For Balanced and Unbalanced Interfaces

Table I
Signaling Speed Table

Speed	Note
16 kb/s	Becoming Available
32 kb/s	Future
48 kb/s	International Only
56 kb/s	North American
64 kb/s	International
1.344 Mb/s	Not encouraged
1.544 Mb/s	T1 Carrier

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